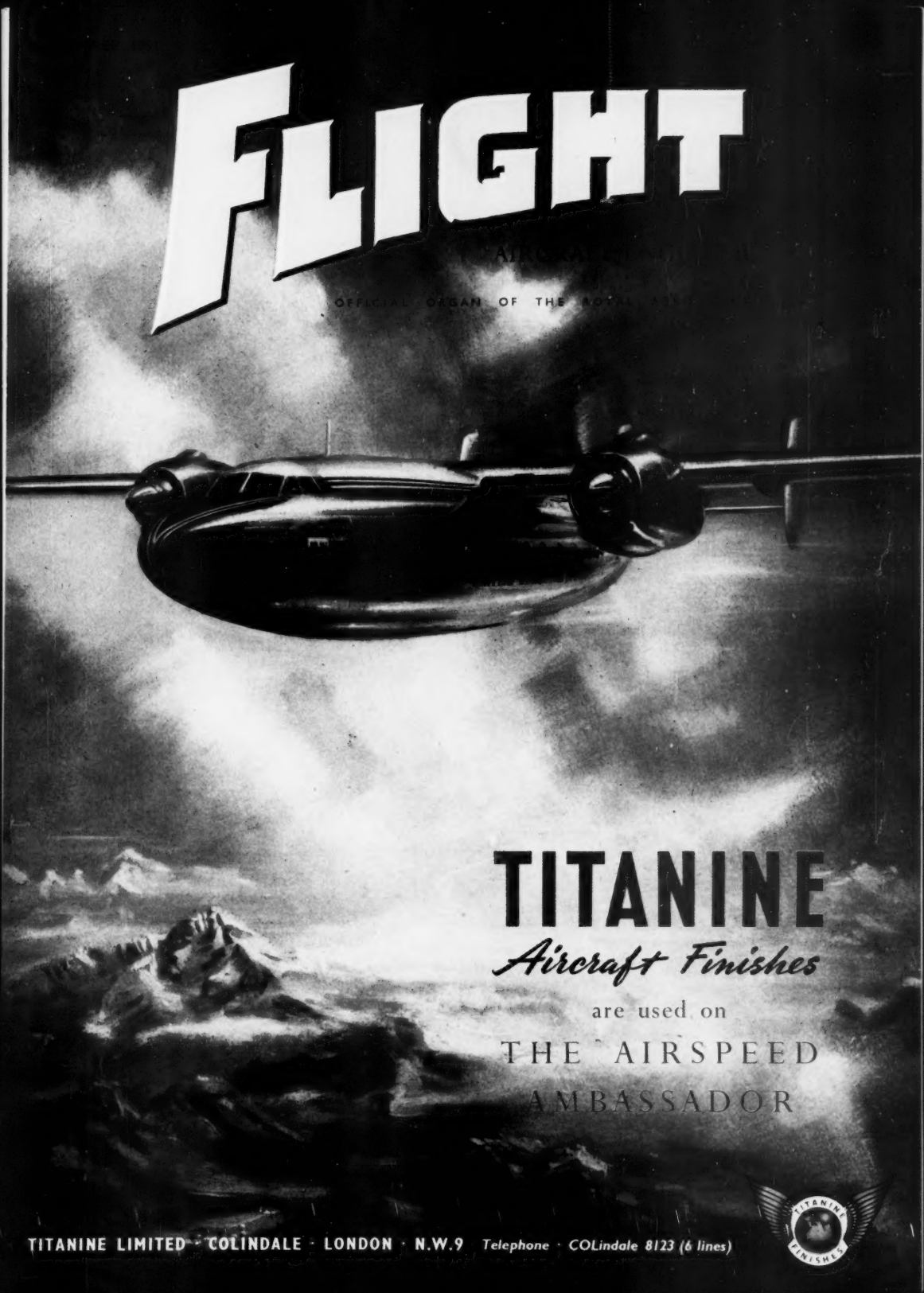
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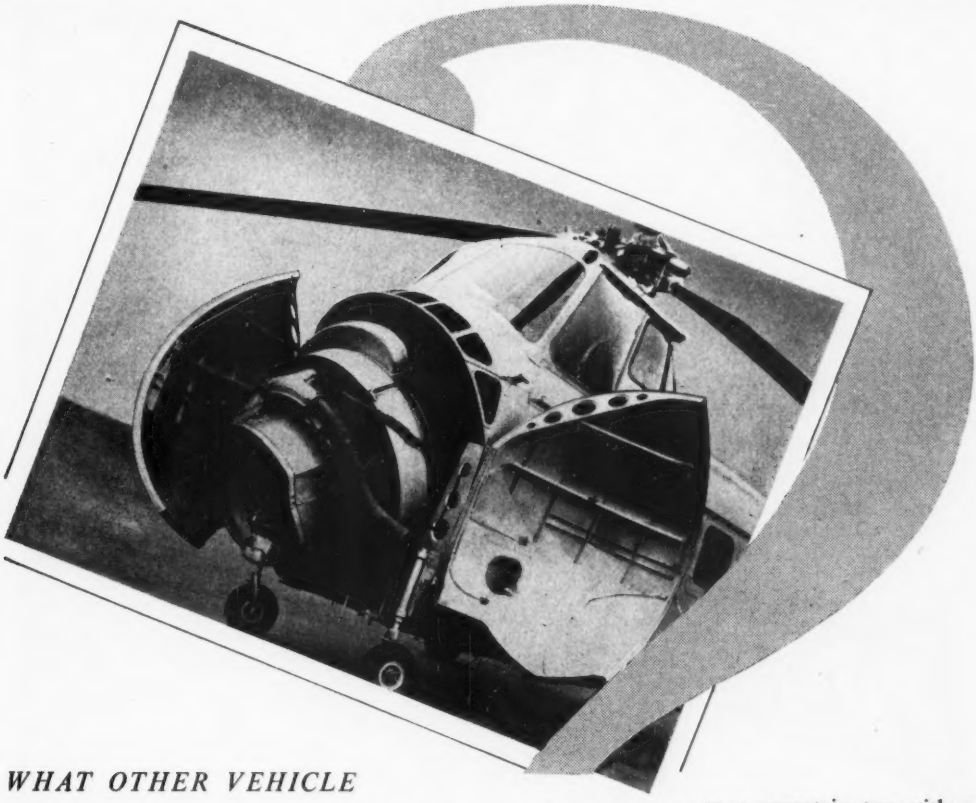

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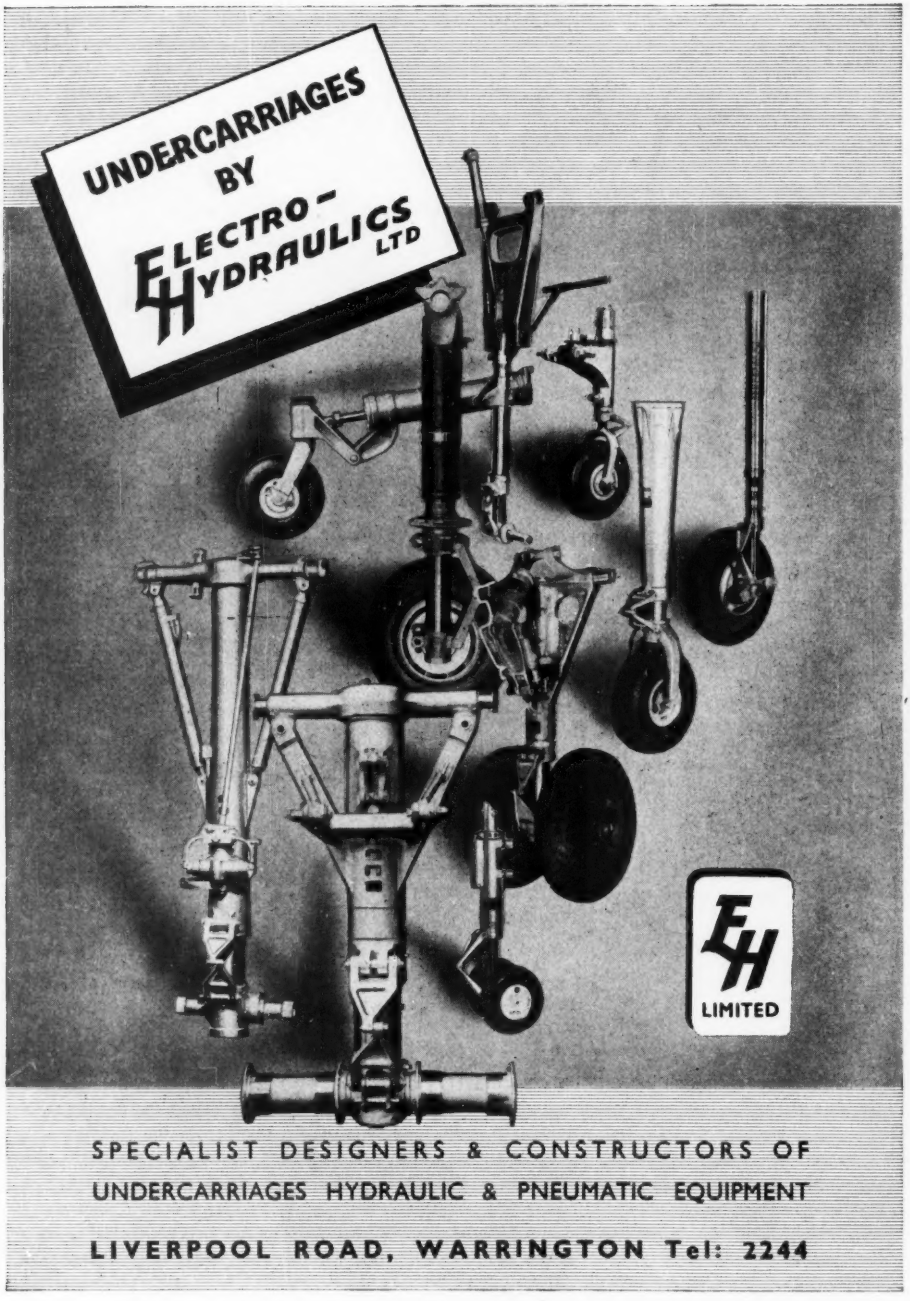
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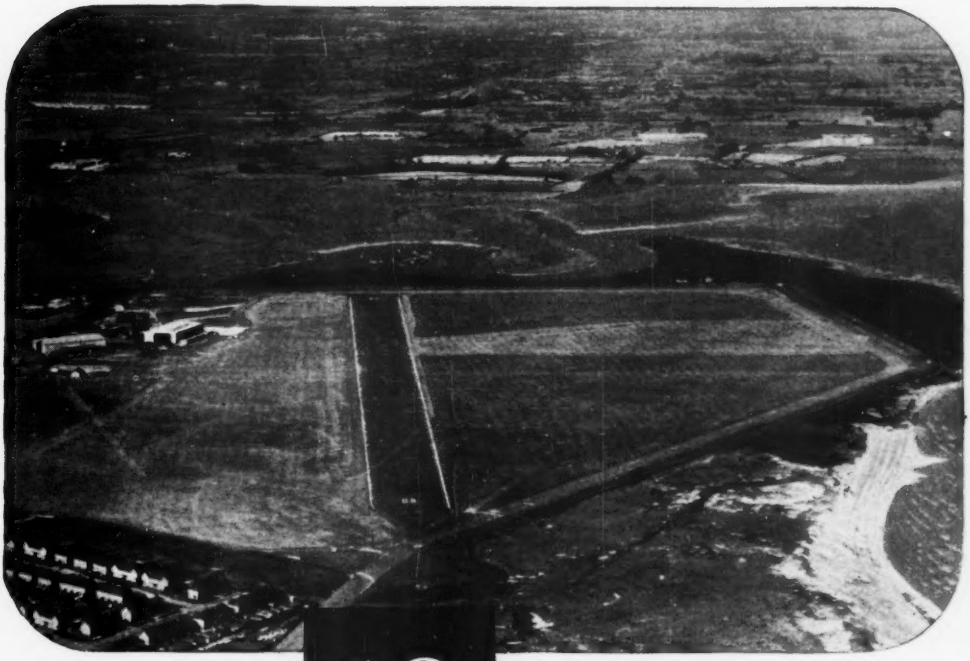

18

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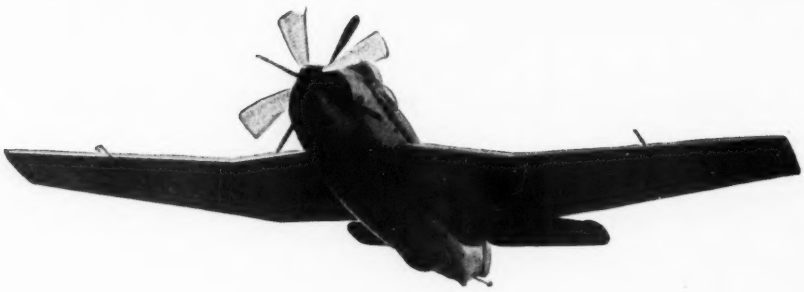
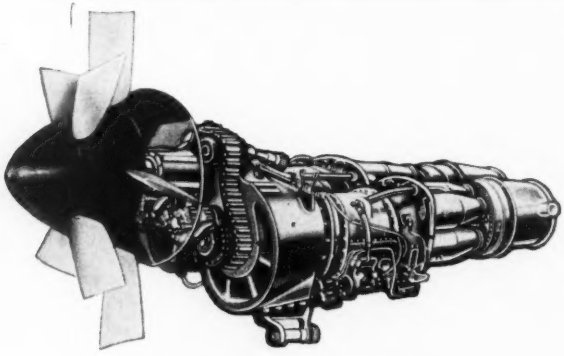


'SINGLE DRAG'

The design benefits of a single engine formula



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Salesmanship versus Availability

THE first jet airliner continues to hold its predominant place in world views and news while earlier designs, fully extended, try to keep pace. Some unusually forthright reading about Comet operation was afforded recently when an American contemporary saw fit to publish extracts from business correspondence between the president of Overseas National Airlines, one of America's larger non-scheduled operators, and the de Havilland Aircraft Co., Ltd. O.N.A. has been negotiating the purchase of two Comet Is, but it now seems that the deal has fallen through because of delays which have enabled Air France to secure the only remaining aircraft in the current production batch.

The primary though indirect cause of the delay was the American Civil Administration Authority's refusal to accept the British Certificate of Airworthiness. Over here we accept the American C. of A. without question: is it not time that the Americans, like the Canadians and others, reciprocated? Their refusal is the more surprising in view of the degree of technical agreement already existing between the two countries; the only acceptable explanation would be the fact that the Comet is a completely new departure. America's lack of civil jet experience may cost her dear.

Overseas National believed that it had a good chance to pioneer jet-transport operation in America in spite of some big operators' opinions that such an attempt would be premature. Together with de Havilland, O.N.A. has worked out figures for typical American routes and a direct operating cost of 406.03 dollars (£145) per hour is quoted. Among the assumptions is a gross-weight figure of 100,000 lb—though from most first-class airports the Comet I should quite happily lift its full 105,000 lb. Our information is that the hourly cost figure quoted may, in any case, be some £25 low.

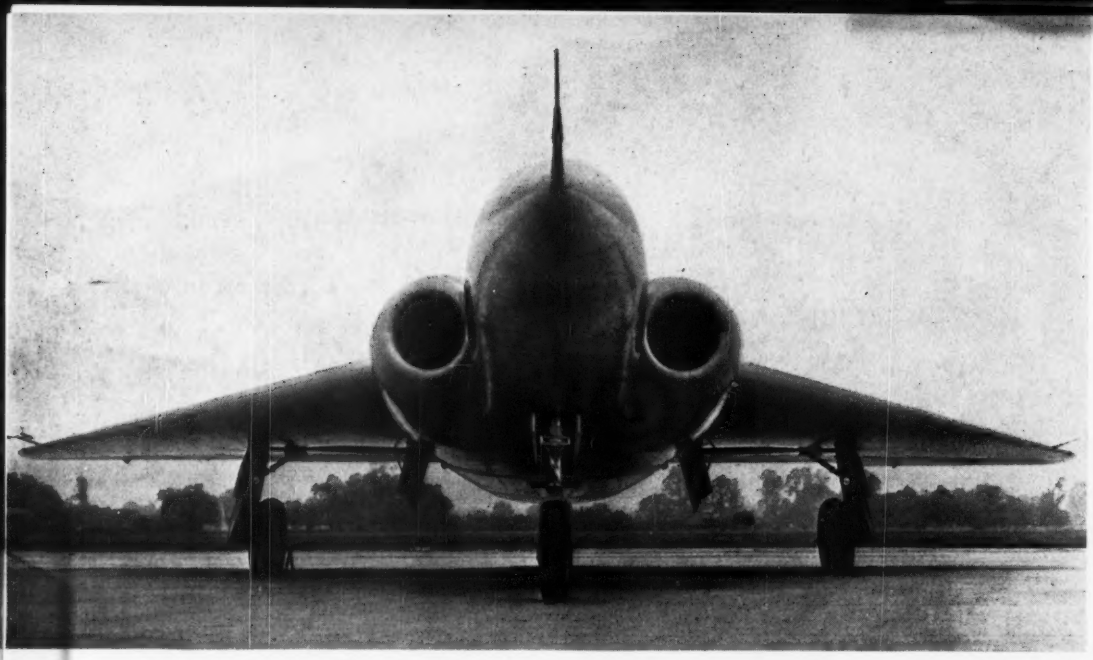
For production reasons de Havilland will probably decide to concentrate entirely on Series II and later marks of Comet after the present batch of Series Is—all now spoken for—has been completed. Potential American operators ought therefore to be considering only Avon-Comet performance and thinking in terms of, say, 115,000 lb a.u.w. In one of their letters to O.N.A., de Havilland indicate that the first date for Series II deliveries with present production facilities would be April, 1955. The accent is, of course, on production capacity. Not only with Comets but with every civil aircraft it is unfortunately becoming a case of what can you get rather than of which would you like.

Giant Helicopters

MR. FITZWILLIAMS' proposals for a family of giant helicopters (the concluding part of his recent lecture is given on pages 728-731) have focused attention on what is undoubtedly, in the present state of world tension, an issue of no little importance. Military payloads of the magnitude quoted in the lecture cannot be disregarded, and on this basis alone the problems associated with the development of such huge aircraft—and they are real enough—must be attacked.

When Mr. Igor Sikorsky gave his lecture over here five months ago, it was evident from the subsequent discussion that many people would prefer the devil they knew to the devil they didn't, and would thus tend to develop centre drive to its ultimate form before being forced to adopt tip drive. Mr. Fitzwilliams, however, makes it clear that, although a new set of problems is intrinsically involved, the installation of turbojet power units at the rotor tips confers advantages in payload and stowage volume (to mention but two considerations) which warrant detailed attention to this new concept of a power installation.

There are, of course, many well-informed people who hold the view that twin rotors are a "must" for all helicopters other than the smallest types; but this view is largely bound up with the matter of single-engine safety and has comparatively little to do with what might be termed rotor safety. That multi-engine power installations must be provided for medium-size and large helicopters is patent, but whether this should also be taken to imply that more than one rotor must be used is open to question. Mr. Sikorsky and Mr. Fitzwilliams believe not, although their suggested solutions to the problem differ. In the present state of the art helicopter safety is bound up in rotor-head design, and any system which leads to a simplification of the hub deserves the utmost attention.



GLOSTER'S SUPER FIGHTER

The Delta-wing, Sapphire-powered G.A.5—a Great-grandchild of the E.28/39

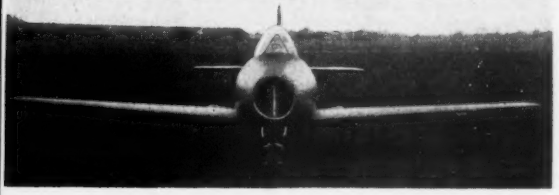
IN every respect the newly announced Gloster delta-wing, long-range, all-weather, radar-equipped fighter appears to be a very remarkable aircraft—certainly the most unorthodox of its class in the world. That fact makes all the more regrettable the necessity for saying little more of its design and construction other than can be learned from the officially approved photograph heading this page and from a formal announcement. This statement gives the designation as G.A.5, the function as "multi-purpose fighter," and the power plant as two Armstrong Siddeley Sapphire turbojets. We may, however, suggest, without laying ourselves open to incarceration in the Tower, that the new fighter has been designed to meet the same requirements as the twin-boom, twin-Avon D.H.110, the first flight of which was on September 26th, and which, it may be recalled, appears to be a two-seater.

The G.A.5 was flown for the first time on November 26th by S/L. W. A. Waterton, A.F.C. and Bar, chief test pilot of the Gloster Aircraft Co., Ltd., at the company's Moreton Valence airfield, and was airborne for 35 minutes. Because, it may be surmised, of the recent accident to the Avro 707B, Waterton had no previous delta experience, though during a protracted sojourn in Canada he became thoroughly accustomed to the Avro Canada CF-100, a twin-jet heavy fighter intended for the same duties as the new Gloster development, though having in this instance a conventional wing plan.

Responsible for the G.A.5, under the technical direction of Mr. George Carter, was Mr. Richard Walker, the company's chief designer. Gloster's general manager, Mr. Percy Crabbe, has commented on the new delta in the following terms: "Since the war we have been building Meteors in a variety of developments. However, whilst Meteor production has been going on, we have been steadily at work in our design and experimental departments on new aircraft just as versatile as the Meteor but adapted for the maximum use not only of current jet power but foreseeable power into the future.

"The G.A.5 delta is our answer to this vital design-problem. The low aspect-ratio of the delta wing provides minimum change in stability and control characteristics at sonic speeds. The delta plan-form permits engines, undercarriage, fuel and equipment to be contained inside one smooth envelope and the shape permits a very rigid and economical construction. The airframe design itself is

Left to right: W. G. Carter, C.B.E., F.R.Ae.S. (technical director, the Gloster Aircraft Co., Ltd.); R. W. Walker, F.R.Ae.S. (chief designer); S/L. W. A. Waterton, A.F.C. and Bar (chief test pilot).



For comparison with the G.A.5 on the opposite page these frontal aspects of (reading down) the E.1/44, Meteor and E.28/39 are reproduced to illustrate evolution. The E.28 first flew with a Whittle turbojet; the Meteor is powered as standard with two Rolls-Royce Derwents, though early versions had a variety of experimental units, and there is a flying test-bed with two Armstrong Siddeley Sapphires; the E.1/44 had a single Nene. The new G.A.5 has two Sapphires.

the corollary to the immense power demands of the twin Sapphires.

"Hawker Siddeley Group, of which we are a member, have been concentrating for some time past on delta development. Our sister company, Avro in Manchester, have done a great deal of the successful basic research on deltas, and we in our Group are convinced that this is the shape of the aircraft of the future. The recent Avro demonstrations of their experimental 707 deltas were convincing proof of the capabilities of this plan-form. There has been a complete interchange of research information between ourselves and Avros on deltas, and since Armstrong Siddeley is another sister company in our Group, there has been extremely close liaison between our designers and the Sapphire jet-engine team at Armstrong Siddeley.

"The G.A.5 is the world's first twin-jet-engined delta. We believe it marks another significant milestone in the lead of British aviation over the rest of the world."

If antecedents are any guide, the G.A.5 should be assured of a most distinguished future, for it is directly descended from the historic E.28/39 of 1941—Britain's first jet-propelled aircraft, in the design of which "requirements for a fixed-gun intercepter" were officially specified. The Meteor, which followed in 1943, was our first twin-jet fighter, and though the next type—the experimental E.1/44—had only a single jet, it was characterized, as our photograph shows, by a very broad fuselage, bearing a striking resemblance, in frontal aspect at least, to that of the G.A.5. The wide-track undercarriage is another E.1/44 feature reproduced in the new delta.

One may speculate as to whether the new fighter has no horizontal tail surfaces or whether a tailplane is fitted—probably temporarily, as on the Fairey F.D.1. Other features, the assessment of which must await further photographic releases, are the cockpit arrangements and the configuration of the fuselage tail-end, in which region, it will be judged from the photograph herewith, the jet streams emerge. It may be remarked that the apparent troughs in the fuselage-sides ahead of the intakes are probably the reflections of the intakes themselves in the highly finished fuselage skinning.

THE O.U.A.S. DINES

FOR their annual dinner this year the Oxford University Air Squadron were able to revert to pre-war practice in holding the function at the Squadron Headquarters in Manor Road. In one particular, however, nothing was changed: as ever, the whole evening was immensely enjoyable.

The Loyal Toast having been honoured, the Commanding Officer, W/C. A. Willan, D.F.C., as is usual in proposing the toast to "The Guests", took the opportunity to review the affairs of the Squadron. First of all, however, he expressed the general regret at the absence of the Chief of the Air Staff, who had had to go to Rome. The Squadron was up to strength—was even a little over strength—and had a short waiting-list.

The C.O. then announced the fateful news that, after 26 years' service, F/L. Jack Acres was leaving the Squadron and he (the C.O.) wondered whether or not he oughtn't to commit ceremonial *hara-kiri* as a result. Acres had always been the greatest friend of the Squadron, and everybody was very sorry to see him go: at the same time, they hoped he would be happy in his new job.

It had been a good year, continued W/C. Willan, and they had done a lot of flying—in fact, he could produce statistics to prove that Oxford was "easily the best U.A.S." They had been lucky in their summer camp at R.A.F. Station, Middle Wallop, and he wished to express the Squadron's appreciation for the hospitality they had received there, and also for the wonderful work done by the civil contractors, Goodhew Aviation.

W/C. Willan then observed that the Squadron had a great tradition, but it had to be remembered that it was a training unit. The best way for squadron members to get in some operational flying was to do it during their National Service. Squadron members who did their National Service in the R.A.F. could, in fact, put in more than six months' operational flying. So far as a career in the R.A.F. was concerned, this was a path which used to be a broad highway, but which was now rather narrow and somewhat overgrown. The only other outlet was through the Auxiliary Air Force, but, in order to get his wings, a man had to fly an advanced type of trainer. He knew that the Auxiliary Air Force wanted University Air Squadron members, and he also knew that there were many O.U.A.S. members who would like to join the Aux. A.F. He hoped it would become possible.

The reply to the toast was made by A. V-M. W. F. MacNeece Foster, C.B., C.B.E., D.S.O., D.F.C., who told a story of a speech he had made at the inauguration of the Chinese Air Staff College; he had been overcome when, at the end of his speech, the senior Chinese officer present said that to have listened to the air vice-marshal speaking for half an hour was equal to a ten years' education. This example of polished ambiguity was most appreciatively received.

A. V-M. MacNeece Foster then announced that he had something *really* interesting to say. In a letter he had received that morning from the Chief of the Air Staff, he had been informed that Fighter Command were to give up 20 Harvards to the University Air Squadrons. This news was, as may well be imagined, received with rapturous applause.

Sir Maurice Bowra, M.A., Warden of Wadham and Vice-Chancellor, proposed the toast of "The Squadron" in a masterly speech. He remarked how, during the mornings, when he was trying to say something, he would be deafened by the noise of aircraft overhead, and he was amazed that these young men were able to do all this in the morning when, of course, they should be attending lectures—or drinking coffee. In concluding his speech, the vice-chancellor said that he knew the Squadron's tenancy was precarious, but he could assure them that, so long as he was alive, the Squadron would be there—and he wished to emphasize that he had every intention of living for a very long time.

The Hon. J. G. T. Lawrence, of New College, replying on behalf of the Squadron, likewise fulfilled his task with wit and polish. From the point of view of the Squadron, the year had been unexciting, although of course, there were tales of derring-do above the clouds—solo, of course. There was pretty tense controversy between Oxford University and London as to who should have the honour of flying underneath Tower Bridge. Mr. Lawrence then referred to the instructors, saying that they were easily recognisable—they were the old, haggard-looking men. Not, he hastened to add, as a result of nerves; they feared nothing but the licensing hours. Speaking more seriously, however, he thought that the Squadron was in fact blessed with first-class instructors. He concluded by referring to the departure of Jack Acres and said that, in wishing him au revoir, they all wished him the best luck in the world

FROM ALL QUARTERS

A New C.A.S.?

ACCORDING to A. Cdre. L. G. S. Payne, writing in *The Daily Telegraph* last Tuesday, it is likely that Marshal of the Royal Air Force Sir John Slessor will relinquish his post as Chief of the Air Staff at the end of next year, or possibly earlier. Sir John, who is 54 years of age, may be succeeded by Air Chief Marshal Sir William Dickson—"but," says A. Cdre. Payne, "the possibility of a younger man being chosen cannot be excluded."

The same writer observes that the appointment of the U.S.A.F. Chief of Staff, General Hoyt S. Vandenberg, expires on April 30th next.

A Still Bigger Boeing Bomber

BOEING'S big new XB-52 emerged from its assembly hangar at Seattle on November 28th—after dark. Mr. Thomas Finletter, U.S. Secretary for Air, said that special efforts—including the use of "drapes, camouflage and other procedures" would be made to maintain security on the details of the new design.

Ordered "off the drawing-board," the B-52 is a stepped-up, eight-jet version of the swept-wing, six-jet B-47 already in quantity production. It is believed that the power units will be the new Pratt and Whitney J-57 axial-flow turbojets, tests of which have been conducted in a B-50 flying test-bed.

News from the I.Ae.S.

THE Fifteenth Wright Brothers Lecture, before the Institute of the Aeronautical Sciences in Washington on December 17th, is to be delivered by Dr. P. B. Walker, M.A., Ph.D., F.R.Ae.S., Head of the Structures Department at the R.A.E., Farnborough. His subject is to be *The Experimental Approach to Aircraft Structural Research*.

Also from the I.Ae.S. comes news that Mr. Wellwood E. Beall has been elected president of the Institute for 1952. Mr. Beall is Boeing's vice-president of engineering and sales, in which post he is responsible for overall direction of the company's aircraft design, production, testing and marketing.

Anglo-U.S. Production: Commons Questions

IN the House of Commons last week, Mr. H. A. Watkinson (Cons., Woking) asked Mr. Duncan Sandys, Minister of Supply, what steps had been taken to integrate aircraft production in the U.S. and Great Britain. The Minister replied: "There is close consultation and a regular exchange of information in these matters between the U.K. and the U.S. as well as other N.A.T.O. countries." Mr. Watkinson then asked the Minister to do what he could to increase this close consultation, because he believed it could be very much to the advantage of the rearmament programmes of both countries if we could get closer integration.

Mr. Sandys: "There is a good deal already going on in this way. The Canberra bomber and the Sapphire jet engine are being produced in the U.S. under licence, and we are also producing under licence here a number of aircraft components and other items."

Mr. F. Beswick (Lab., Uxbridge) asked the Minister to see to it that in any integration this country was not again left to specialize in military types while America was left with all the transport aircraft.

Mr. Sandys: "Yes, it would be unwise to make ourselves entirely dependent on the United States for any particular item."

Asked by A. Cdre. Harvey (Cons., Macclesfield) if he would make a statement on the future of the Brabazon, the Minister of Supply said: "I am reviewing the aircraft programme as a whole. Meanwhile, I should prefer not to make a statement on particular projects."

A. Cdre. Harvey: "As a lot of public money has been spent on this project, will the Minister give an undertaking that he will make a decision at a very early date?"

Mr. Sandys: "I hope to be able to make a statement quite soon."

Two days later, in a written reply to Sir Herbert Williams (Cons., Croydon East), Mr. A. R. W. Low (Parliamentary Secretary, Ministry of Supply) said that the first Brabazon cost about £4 million and had flown for 350 hr.

A Canadian-Bristol Appointment

IT is announced that Mr. William D. Kennedy has joined the Bristol Aeroplane Company of Canada, Ltd., and is to act as general manager of Bristol Aeroplane Engines (Western), Ltd., at Vancouver, B.C.

Mr. Kennedy, a native of the Mid-Western United States, was formerly vice-president and general manager of the Wright Aeronautical Corporation. He has been connected with aviation since 1915 and served in the Aviation Section of the U.S. Army Signal Corps in World War I. After that war he was employed by the U.S. Army Air Corps as civilian Chief of Maintenance until 1928, when he joined the Wright Corporation. In 1948 President Truman awarded him the President's Certificate of Merit for "manufacture and production of aircraft engines." He is an Associate Fellow of the Institute of the Aeronautical Sciences, and a member of the American Ordnance Association and the American Association for the Advancement of Science.

Manpower and Production

FIGURES recently extracted by the S.B.A.C. from official statistics show that the number of persons engaged in the manufacture and repair of aircraft in this country reached 161,900 at the end of August, an increase of 1,900 from July. The July total was 900 greater than the figure for June. These figures are still lower than the increases for the second two months of the year, which averaged approximately 2,280 and far less than are needed for the programme as planned.

Implications of this shortage of manpower, as underlined by Air Chief Marshal Sir Guy Garrod in a recent speech on behalf of the Air League, were discussed in a leading article in *Flight* of November 9th.

	Males	Females	Total
September (1950)	125,200	21,700	146,900
October	125,600	22,300	147,900
November	126,300	22,300	148,600
December	127,200	22,400	149,600
January (1951)	130,000	23,100	153,100
February	131,700	23,600	155,300
March	132,900	23,700	156,600
April	133,900	24,000	157,900
May	134,100	24,200	158,300
June	134,700	24,400	159,100
July	135,500	24,500	160,000
August	137,000	24,900	161,900

PROMISING FRENCH FIGHTER: An intimate new aerial view of the Dassault M.D.452 Mystère just received from France. In Paris it is being said that, during a recent mock high-altitude engagement over the Marseilles area, a Mystère out-manoeuvred a Sabre; whether the machine concerned was powered with a standard Hispano Nene or the more powerful Tay is not revealed. The Mystère is, of course, a swept-wing development of the Ouragan.

Migs Over Korea

ABOUT this time last year, when a member of our staff returned from the Far East, he forecast a Chinese air force of 1,000 front-line aircraft. The latest news from Korea confirms this estimate. Gradually air resistance has built up from nothing until, last week-end, air battles comparable with those over Britain and the Continent in the last war developed.

United Nations' pilots flying 30 Sabres attacked a formation of 12 twin-engined bombers and destroyed half of them. Of the protecting Russian fighters three of the piston-engined types were shot down out of a total of 18 and of the 16 Mig-15s one was destroyed. It is thought that the bombers were Tu-2s and the piston-engined fighters La-9s.

An American 5th Air Force spokesman said the bombers were intercepted while they were on a training mission near Antung, just over the North Korean border. They were flying between 15,000ft and 20,000ft at an estimated speed of 300 m.p.h. Battle was joined from below instead of from the more usual dive out of the sun.

U.S.A.F. Beavers Delivered

AT a ceremony at the Toronto factory of the de Havilland Aircraft of Canada, Ltd., on November 13, the first three of a large number of D.H. Beavers ordered by the U.S.A.F. were formally delivered.

The handing over was performed by Canada's Defence Production Minister, Mr. C. D. Howe, and the aircraft were received on behalf of the U.S.A.F. by Maj. Gen. Mark E. Bradley, Director of Procurement and Production, Air Materiel Command.

Though these three aircraft were the first of the actual order, the U.S.A.F. has been operating several "sample" Beavers since the early part of the year.

Gas Turbine School's Progress

THE School of Gas Turbine Technology has now completed its first year in its new premises at Farnborough. Mr. W. E. P. Johnson, managing director of Power Jets (Research and Development), Ltd., who operate the school, said last week:—

"Reports from many outside sources show that our activities are not only extremely useful to the individual pupils but are playing an important part in the dissemination of technology throughout industry. Most striking of all is the prominent way in which we are fixing British technology in the minds of engineers from overseas. We are establishing international links which, I believe, will draw foreign custom to this country with a snowball-like effect. It is not only at home that the importance of the proper use of fuel and heat energy is being realized. We believe that the gas turbine has a prominent part to play in this respect."

During the year, 311 students have passed through the school, which held 17 courses, including two special international sessions for overseas students. Six courses are already scheduled for 1952. These include two industrial gas-turbine courses, two on aircraft-engine design, a practical aircraft-engine course and an international course covering both aircraft and industrial gas turbines.

From the Old to the New

SOME little while ago, certain of the original apprentices of the Sopwith Aviation Company, forerunner of Hawkers, had the very pleasant thought that they would donate a trophy for presentation annually to the best Hawker apprentice. On Friday evening last, November 30th, the first presentation of the trophy, an extremely handsome shield, was made in very happy circumstances at the Canbury Park Road, Kingston-on-Thames, headquarters of Hawker Aircraft, Ltd.

Mr. R. W. Sutton, now a director of Dowty Equipment, Ltd., introduced some of the trophy donors to the audience, and said that, although not himself a Sopwith apprentice (he was a clerk at the time) he had been secretary of the Sopwith Apprentices' Association. The donors present on the platform were : Captain H. Duncan Davis, A.F.C.; Mr. Jack Williams; Mr. Frank Buckle; W/C. W. W. Warner; and Mr. M. F. C. A. Brothers.

Having received the trophy on behalf of the apprentices, Mr. A. Neville Spriggs said that, although the old apprentices had not had the facilities that youngsters had today, they had nevertheless risen to great heights, and it should be remembered that similar advancement was open to apprentices today. The industry was desperate for skilled technicians, and he could assure his audience that the directors kept a keen eye on them all; as soon as a bright youngster was noticed, he was given every opportunity to succeed.

Mr. Spriggs said that he was honoured to receive the shield on behalf of the firm, and was sure that, as the years went on, it would be increasingly valued.

Mr. Sydney Camm then presented the shield to the winning apprentice of the year, Mr A. H. Goddard, who made a touchingly sincere speech of thanks. Mr. Sutton then interposed to say that he had been told that Mr. Goddard was regarded as "the finest apprentice the company had ever had." The remaining prize-winning apprentices were Messrs. A. N. Clark; N. P. Deane; J. W. Hawkins; A. E. Sheridan; R. O. Holden; R. B. Thomas; and N. Upton. The last three named are all serving in the Forces, and only Mr. Thomas was present to receive his prize personally, Mr. Barton, the apprentices' supervisor, accepting the prizes on behalf of the other two.

"Flight" photograph

G.A.P.A.N. INSTALLATION: As recently reported in "Flight," H.R.H. Princess Elizabeth, Grand Master of the Guild of Air Pilots and Air Navigators of the British Empire, has indicated her intention to preside over the annual installation ceremony and presentation of the Guild's trophies at the Mansion House tonight. Mr. John Lankester Parker, O.B.E., F.R.Ae.S. (above) director of Short Bros. and Harland, Ltd., who will be installed as Master, is one of the industry's best-known and best-liked elder test pilots. He became chief test pilot to Short Bros. in 1916.

Mr. Camm made a brief speech in which he paid tribute to those who had worked for him over the years, saying that his job depended so much on the people who worked with him. Hawkers had given five or six chief designers to the industry [surely a unique record—Ed.] and the company had employees who had worked both on the 1913 Sopwith Scout and also on the latest Hawker jet aircraft. Mr. Camm then made the salutory observation that too much glamour was given to design as a job; production was no less important.

To conclude the official proceedings of the evening, 23 employees of the company who had completed 25 years' service were presented with clocks.

Value of Aeromodelling

INDICATIVE of the value which the R.A.F. places upon the model-flying movement as a means of encouraging the technical enthusiasm of young men was the strong Service representation at the annual dinner and dance of the Northern Heights Model Flying Club, held in London on November 29th. The guest of honour was the A.O.C.-in-C. Bomber Command, Air Chief Marshal Sir Hugh P. Lloyd, K.B.E., C.B., M.C., D.F.C., who is president of the R.A.F. Model Association. Halton—always an active centre of aeromodelling—was represented by the Air Commodore Commanding, A. Cdre. J. G. Elton, C.B.E., D.F.C., A.F.C., and the Deputy Commandant, G/C. D. O. Finlay, D.F.C., A.F.C., while a guest from Naval Aviation was Lt.-Cdr. J. S. Sproule, whose sailplane aerobatics have been a high-spot of so many naval air displays. The aircraft industry was represented also, for another guest was Mr. Neville Spriggs, O.B.E., director and general manager of Hawker Aircraft, Ltd., who put their Langley Airfield at the Club's disposal for the annual gala day.

Sir Hugh Lloyd responded to the toast of "The Guests," which had been proposed by Mr. M. A. L. Coote (technical secretary of the Society of Model Aeronautical Engineers), whilst Mr. C. A. Rippon (a Fellow of the S.M.A.E., and founder and past president of the N.H.M.F.C.) replied to the toast of "The Club," proposed by the representative of *Flight*. Other speakers included Lady Lloyd and Major H. J. N. Nicholls, and Mrs. Neville Spriggs presented the prizes.

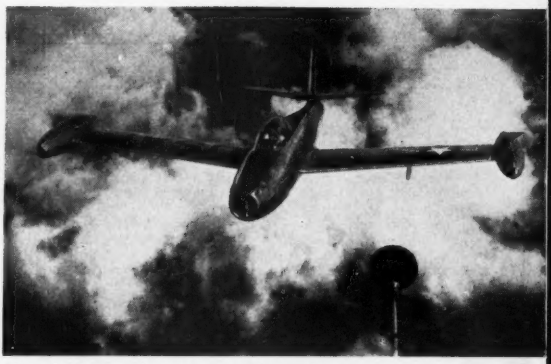
Every speaker referred in appreciative terms to the work of the Club's president, Dr. A. P. Thurston, M.B.E., D.Sc., M.I.Mech.E., F.R.Ae.S., who, incidentally, recently celebrated his 70th birthday by (to quote from Sir Hugh Lloyd's speech) "taking off in an Auster, flying to France drinking a bottle of wine, putting another under the counter, and getting away with it."

Mr. R. Copland, this year's winner of the Queen's Cup, aroused considerable interest by announcing that Her Majesty had approved a new set of rules for the next contest. In future it is to be for power-driven models of under 5 c.c. with lifting-surface of between 975 and 1,025 sq in and a minimum weight of 30 oz; a bonus is to be given for a landing within a stipulated area.

FOX-ABLE-FOUR

An Epoch-making Operation Studied in Perspective: The Flight-refuelled Atlantic Crossing by Two F-84E Thunderjets

By
CAPTAIN NORMAN MACMILLAN
M.C., A.F.C.



A Thunderjet as seen from the tanker. The pilot is approaching to make contact between his wing-mounted probe and the trailing hose drogue.

IN this absorbing study of the flight-refuelling techniques employed by the two F-84E Thunderjets which crossed the Atlantic non-stop fourteen months ago, Capt. Norman Macmillan reveals some of the problems attendant upon operations of this kind. He concludes by suggesting a strategic plan for regular flight-refuelled direct crossings by jet fighters and—ultimately, in a more peaceful world—by commercial aircraft. Partly through the lessons learned from Fox-Able-Four (the operation code-name) and partly by means of the routine research which they conduct unceasingly, Flight Refuelling, Ltd., have already brought their system several steps nearer perfection.

ALTHOUGH considerable operational experience has already been gained in the flight refuelling of jet fighters, only one really-long-range non-stop flight, so far as the writer knows, has yet been made by aircraft of this type. That was the east-to-west Transatlantic flight by two U.S.A.F. Thunderjets in 1950.

I have read the American account of this flight in the *Saturday Evening Post*—a cleverly drawn humanistic story spotlighting the gallantry of the exploit to appeal to the emotionalism of the wide American public which reads that excellent journal; I have also been privileged to read the more prosaic reports of the captains of the two British tanker aircraft who took part in the flight programme; and, as a result, I am now convinced that close study of the non-stop transfer of jet fighters from one continent to another has reached the stage of military necessity.

A glance at the world map will immediately disclose the desirability for Allied planning of just such mobility in jet fighters, not only between U.S.A. and U.K., but between U.S.A.-U.K. and Australia, and anywhere between U.K., Malta, Kenya and Singapore.

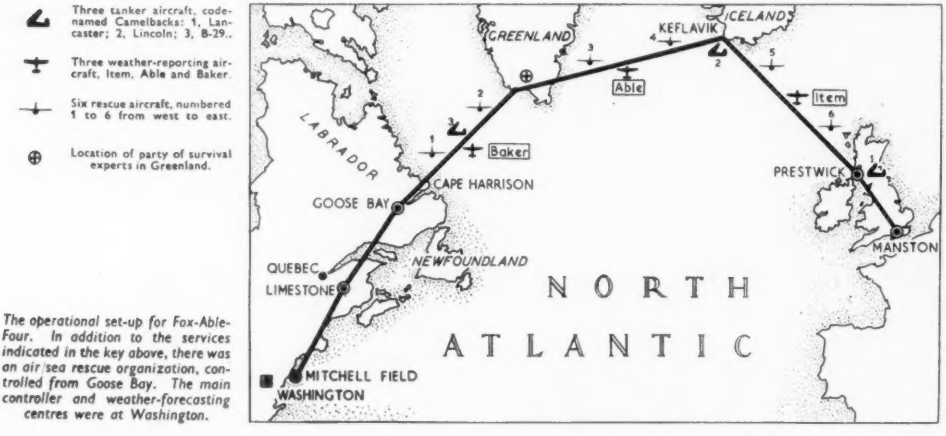
In the last war, fighters had to be ferried to Norway, Malta and Singapore in aircraft carriers. That method was slow. All history indicates that speed of movement is a cardinal military principle. To gain full value from that speed it must be maintained, without hesitation or slackening, from point of departure to the combat zone. Thus, the military value of the jet fighter may depend upon its power to leap over oceans and continents. The Transatlantic flight of the Thunderjets proves this can be done.

In 1948 Col. David C. Schilling of the U.S.A.F. led sixteen F-84 fighters on a ferry flight from the United States to Germany. They landed in Labrador, Greenland, Iceland and Scotland to pick up fuel, and the transit took two days and a half. In October, 1949, Col. Schilling visited Flight Refuelling, Ltd., at Tarrant Rushton in Dorset and saw a demonstration of in-flight refuelling by the probe-and-drogue method. He tried it himself, and found it easy enough to steer the probe into the cone of the drogue trailing at the end of the tanker's hoseline. Here was a means to cross the Atlantic non-stop. The U.S.A.F. decided to put it to the test. Schilling was entrusted with the drafting of the flight plan and the execution of the mission. It received the code-name Fox-Able-Four.

Two F-84E Thunderjets were flown from the U.S.A. to Tarrant Rushton to be modified as receivers, and a B-29 came to be fitted as a tanker. Lt.-Col. Albert W. Schinz, a friend of Schilling's, was appointed flight controller, and Lt.-Col. William D. Ritchie was nominated to pilot the second F-84E.

I have been told that the flight plan which Col. Schilling drew up was comprehensive down to the last detail—a perfect model of what such experimental flight plans should be. Here, we need concern ourselves only with its main provisions. The fighters were to take off from Manston, Kent, refuel from British tankers off Prestwick and Keflavik, and from the American-crewed B-29 tanker midway between Greenland and Cape Harrison (Labrador). The destination was Mitchell Field, Long Island, New York.

One weather-reporting aircraft was to patrol a position midway between each landfall. A rescue aircraft was to operate from a point midway between each landfall and each weather-reporting machine. Twelve aircraft were thus to be strung out from Prestwick to Cape Harrison to feed and guard the flight of the two



The operational set-up for Fox-Able-Four. In addition to the services indicated in the key above, there was an air/sea rescue organization, controlled from Goose Bay. The main controller and weather-forecasting centres were at Washington.

Givers and takers: (Left to right) Capt. T. C. Marks, who piloted the Lancaster tanker operating from Prestwick; Capt. P. R. Hornidge, who flew the Lincoln tanker from Keflavik; and the two F-84E pilots, Col. David C. Schilling and Lt.-Col. William D. Ritchie.

Thunderjets. Survival experts were stationed in Greenland, and air-rescue parties at Goose Bay. Take-off was to be 1300 hr G.M.T., estimated to bring the Thunderjets to Mitchell Field before nightfall. Schilling fixed the weather minima, and the flight was not to take place if the head-wind component was above 75 kt.

Telephone batteries with radio-channel links fed information into Schinz's headquarters in Washington, giving instant communication with London and throughout the route. Maj. John J. Allen, a meteorologist of the U.S.A.F. Weather Analysis Division, was to choose the date. Under him were six assistants. Their charts covered the atmosphere from sea level to 45,000ft. Zebra was the code-name for the day which they would name, the day on which the two Thunderjets would stick out their necks.

Meanwhile, Flight Refuelling, Ltd., equipped the aircraft. Probes were fitted to the Thunderjets and connected through galleries to the fuel tanks. High-pressure fuel and shut-off valves in the tanks admitted the fuel without surge or spill. Radar responder-beacons, added to the fighters' V.H.F., provided for navigational contacts with the tankers.

All these arrangements took time to organize and complete. This left little opportunity for airborne practice in the actual operation of making contact between receiver and tanker, which, although simple enough as an over-airfield test or demonstration, requires some practice. The receiver pilot has to approach from behind and below the tanker with an excess speed of between five and ten miles an hour, and stab his probe into the drogue as nearly as possible in alignment with the fore-and-aft axis of the cone. Excessive speed of contact, malalignment, or last-moment yaw are all undesirable. Although there is great flexibility in the length of hose which is run out from the tanker, it is obvious that accurate alignment at the instant of contact between probe and drogue is the best drill. And, once contact has been made, accurate formation flying saves the probe from bending moments which it should not be required to take, though it can do so.

The original programme was set for June, but was cancelled when all F-84E fighters were grounded for an engine modification. That, I suppose, explains why the British tanker captains feel that the air exercises for the flight were too curtailed to produce the slick proficiency in all weathers that they call first-class contact air-drill. The British captains would have liked more of this drill before the flight started, and they still think, in retrospect, that there was not enough of it. I state their views without comment, for they should know. And, for the same reason, there was insufficient time to remedy any faults in the radio equipment. Presumably, however, the two American colonels felt that they had the job buttoned up.

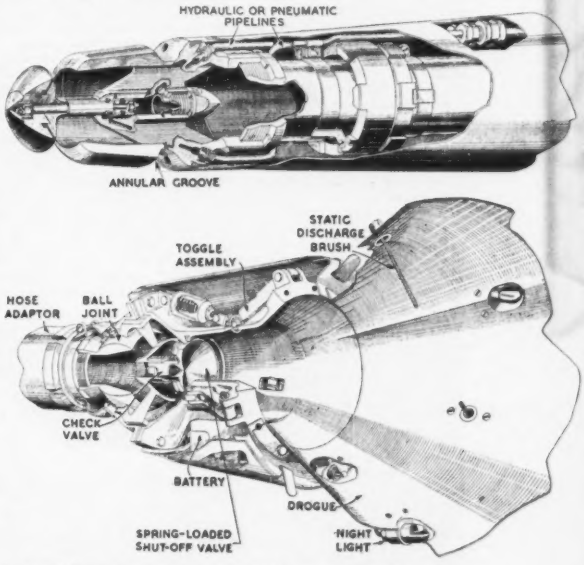
September 18th was named by the American forecasters as meteorologically perfect for the passage, and Capt. P. R. Hornidge left Tarrant Rushton in a Lincoln tanker two days before. He landed at Prestwick by O.C.A. in a 45-kt wind and heavy rain Weather delayed his arrival at Keflavik until 1742 G.M.T. on September 18th.

Capt. T. C. Marks left Tarrant Rushton for Manston on September 17th in a Lancaster tanker. He had arranged to rendezvous with and refuel Col. Schilling's F-84E (piloted by Lt. Julian) in a test of equipment, but the fighter was grounded by engine trouble. Next day, with a radar range of 50 miles, the Thunderjet was intercepted near Bovington at 15,000ft. Marks met Col. Ritchie in the other fighter, also at 15,000ft, near Manston, but radar-beacon reception was shortened by a loose receiver aerial in the fighter.

On September 19th a snap decision was taken to start. The weather forecast was good when the Lancaster left Manston for Prestwick at 0917 hr. It received satisfactory signals from the beacons in the F-84Es on the airfield at 12 to 15 miles range. The fighters took off from Manston at 1245.

When he arrived over Prestwick, Marks found the weather deteriorating. Ten minutes after the Thunderjets left Manston, clouds came in over Prestwick from the west, and the zone was blanketed from 30,000ft down to 2,000. Marks, searching in the Lancaster to a distance of 50 to 70 miles, could find no clear patch. V.H.F. contact was made with the fighters, and it was decided to go below the overcast. At 2,500ft Marks orbited Prestwick, but was unable to maintain a straight and level course for any length of time.

One beacon established contact at 40 miles. The fighters let down on radio compass and broke cloud, at 1,000ft, north of Prestwick. The tanker turned north and the fighters south. The



Probe and drogue in part-section, showing the arrangement of the valves. Coupling is complete when the spring-loaded toggles in the drogue engage the annular groove round the probe. The mushroom-shaped fuel valve at the tip of the probe is hydraulically (or pneumatically) controlled by the pilot; it also serves to force open the spring-loaded shut-off valve in the drogue. Only about one-third of the drogue cone is included in this drawing.

FOX-ABLE-FOUR . . .

Feeding time: One of the two F-84Es takes fuel from Hornidge's Lincoln tanker near Keflavik.

Lancaster gave ranges on radar, while Prestwick G.C.A. gave the fighters the course back to the airfield. The tanker was now flying below the main cloud-base at 1,500ft. A broken cloud layer spread across the ground at about 1,200ft. At six miles' radar range Col. Schilling asked Marks to reduce height below 1,200ft.

The Lancaster came down to 1,000ft and flew with the refuelling hose trailing and ready for contact. The Thunderjets were flying at about 500ft in heavy rain when Schilling saw the tanker three miles away and turned visually towards it. He made contact in calm conditions in heavy rain at 165 kt I.A.S. The tanker operator reported "contact made" to his captain. Thirty seconds later he reported "contact broken." Schilling said, "There is something wrong with the reel" and that his probe valve was bent. He could not take fuel, and would return to Manston.

The Lancaster flew back to Tarrant Rushton, where the drogue was found slightly damaged and scored. It was repaired and sent to Manston by road, where the tanker had already flown. At Manston a new probe was fitted to the Thunderjet.

Meanwhile, at Keflavik, the Lincoln tanker had taken off at 1333 G.M.T. loaded to 81,000 lb. While the undercarriage was being retracted the oil pressure and temperature of No. 3 engine fell to zero. Immediately afterwards that engine's fire-warning light lit up. The crew took action stations; but no external fire was seen, and it was decided to continue the patrol. At 1450 Keflavik tower R/T. reported that the Fox-Able-Four aircraft were returning to Manston. Captain Hornidge thereupon turned back to Keflavik and landed at 11,000 lb overweight. At the end of the landing run, oil on one of the exhaust stacks caught fire, and the engine was stopped at once.

It was found that flames from a shattered exhaust stub had played down inside the engine cowling, damaging electric cables, and overheating the engine bearers. A C-47 flew a new power plant in to Keflavik next day at 2334 hours G.M.T. The damaged engine had meanwhile been prepared for lifting out of the Lincoln. Engineers of the Lockheed organization unloaded the C-47, and Flight Refuelling personnel, working in the open, began to instal the new engine at 0700 hr on September 21. At 1940 that day a twenty-minute test flight was satisfactory, and an "aircraft serviceable" signal went to the U.S.A.F. 3rd Air Division in England.

At Manston the Lancaster and Thunderjets made tests of radar and refuelling, both on the ground and in flight.

Zebra was announced on September 22nd. Marks left Manston, followed by the Thunderjets at 1303 G.M.T. Radio reception was exceptionally good. V.H.F. was established at about 300 miles. The tanker's screen responded to the radar beacon in Col. Ritchie's Thunderjet at 115 miles, and the navigator gave the American pilots ranges and directions until the fighters gained visual contact at eight miles when 90 n.m. north of Prestwick. Flying at 18,000ft, Col Schilling made contact at 165 kt and, flying low and to starboard, took fuel for 6½ min. The indicator light for his forward auxiliary tank did not go out to signal that it was full, and it was evident that this tank was not filling properly.

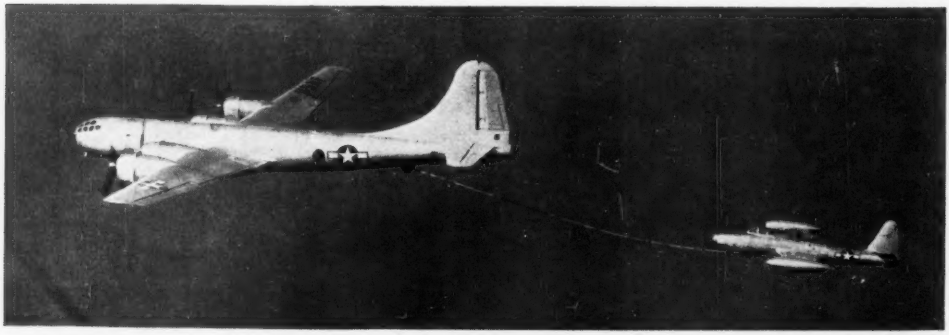
Ritchie then came in and also made contact on the first approach. All his tanks filled in 3½ min, and all his tell-tale lights went out. The two fighters together drew 750 Imperial gallons from the tanker, but it is not known how much each one took. Ritchie broke away 120 n.m. north of Prestwick, and the fighters climbed away on course to their cruising height of about 38,000ft.

Over the first weather-reporting ship between Scotland and Iceland they were 23 min behind schedule, and before reaching Iceland Schilling was advised by Washington, through Keflavik, that head-winds would be 65 kt in Zone 3.

Capt. Hornidge was patrolling in the Lincoln tanker 40 to 60 miles out on the west leg of the Reykjavik range at 12,000ft when he heard the fighters on V.H.F. 150 miles to the east. But Schilling's V.H.F. was giving trouble, so Ritchie took the lead. Keflavik tower relayed a message from the Lincoln asking the fighter pilots to switch on their Eureka beacons; but the Lincoln's screen could not pick up their radar, and the fighters flew west of Keflavik at altitude without making visual contact. When the Lincoln was about 75 miles out Hornidge decided to fly back over Keflavik's radio cone of silence; Ritchie, still leading, agreed.

The fighters let down over the cone. Ritchie was asked to code his beacon when over Keflavik. Immediately a large blip appeared on the Lincoln screen, and a few moments later the fighters' position on the screen was confirmed visually. From then onwards the radar reception was perfect, indicating an earlier fault in the switch-gear, or that the beacon had not been correctly switched on.

With the fighters and the tanker in visual contact, course was set from Keflavik, and the three aircraft flew in formation. As a long leg lay ahead, Schilling wanted to refuel as far west as possible. At 96 n.m. from Keflavik, Schilling came in, missed contact at his first attempt, but made it on the second run in. After 400 U.S. gallons had passed, the fighter broke away, flying low and to the right. Twice more this happened. The fighter pilot reported that no fuel had flowed to his forward auxiliary tank. He made contact a fourth time, fuel flowed for about 20 secs, and then the



A Thunderjet, during a practice run, establishes contact with the B-29 tanker flown by Lt.-Col. William Bacon between Labrador and Greenland.

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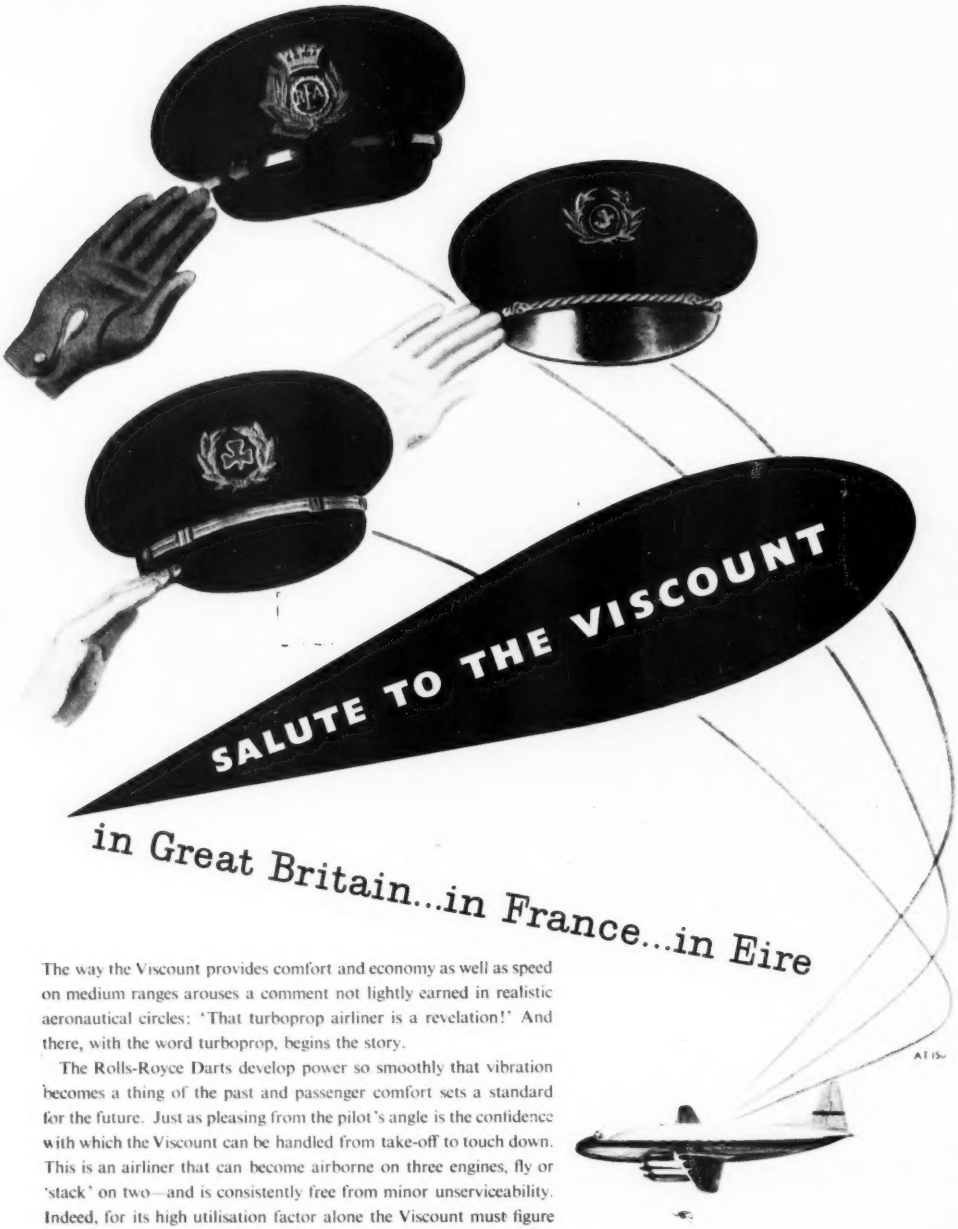

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FOX-ABLE-FOUR . . .

fighter broke away so fast that the tanker operator had to counter the pull on the hose with the drum brake.

Ritchie then came in, and also missed at his first approach. His second approach was good and steady, he made contact, and in four minutes his tanks were full. The two Thunderjets had taken a total of 1,345 gallons. Ritchie's breakaway was as good as his approach, but when he was clear fuel was seen escaping from his probe in large quantities, indicating that the nozzle valve was still fully open, or nearly so. (The hydraulic pipeline to operate the ram for opening and closing valve was then of very fine bore, and it is possible that in very cold conditions the closing of the nozzle valve might have been sluggish. This design-detail has since been modified.) Luckily, the volume spilling from the probe quickly diminished, and when the fighter was last seen from the tanker only a small quantity was escaping.

The two Thunderjets left the Lincoln climbing on course, 160 n.m. west of Keflavik. About five minutes later Schilling asked the Lincoln to transmit a request through Keflavik for the B-29 tanker to fly to Bluie West (Greenland) with all speed. Asked if he wanted the Lincoln to stand by, he said no, but added that it appeared very probable that they would have to abandon the flight at Bluie West owing to fuel shortage and strong head-winds. About ten minutes after that Ritchie was heard telling his leader that the nozzle valve was still open about an eighth of an inch, but that only a slight leak of fuel was then occurring.

The B-29 tanker did not reach Bluie West. The Thunderjets came over the third weather-ship at 43,000ft, with the tanker orbiting at 15,000ft. The tanker was difficult to find so far below, because Schilling's radar was faulty. The leader's tanks were almost dry by the time he made contact with the drogue trailed from the B-29 commanded by Lt.-Col. William Bacon of the U.S.A.F. Two of Schilling's tanks refused fuel. He filled the others, then backed off to let Ritchie come in.

Meanwhile the Fox-Able-Four controller in Washington was laying on plans for emergency. The Thunderjets were 1½ hours late because of head-winds, and a Washington forecast now gave the head-wind as about 150 kt; the stratospheric jet-stream was whistling up, and the F-84Es were themselves experiencing head-winds of about 190 kt. A storm was brewing over New York, and there was risk that fog might fold over Mitchell Field at sunset. For a tired pilot to try to land at Mitchell by G.C.A. when nearly out of fuel was too big a chance, and Schinz radioed that Fox-Able-Four would land at Limestone, Maine—if they got there.

Ritchie had refused to fall out and land at Bluie West. He still had enough fuel to reach Goose Bay if he ignored the B-29 tanker and flew straight on at cruising height. But he decided this flight was a test, and came down with Schilling. Waiting at low altitude for his leader to take fuel, he was using his reserves still faster.

His turn coming at last, he made contact three times with the B-29—once with the nozzle valve thrust wide open. But he could get no fuel; evidently the probe valve had been damaged on the second fuelling and now would not operate the valve within the reception coupling of the drogue.

His tanks now held just enough to carry him to Cape Harrison. The tanker's radio alerted the rescue service. Bacon gave Ritchie his course and distance to Cape Harrison and the lone Thunderjet climbed to 38,000ft and streaked westward.

Ritchie began to glide before using his last drop of fuel. Cape Harrison took a bearing on his transmitting radio and gave him a course-to-steer. At 20,000ft he was in opaque mist, but he broke through at 12,500ft above water and birch-covered hills; Goose Bay radio said he was above Melville Lake, 40 miles inland. He restarted his engine. The last drop of fuel dried up at 7,000ft, and the turbojet's roar died away. The F-84E was 30 miles from Goose Bay. Ritchie radioed a message to his wife in New York through Schilling. At 3,000ft he blew off his canopy, and in a puff of cartridge-smoke his ejector seat threw him clear. The aircraft fell into Melville Lake.

The pilot slid down a tree that had hooked up his parachute canopy. Rescue aircraft spotted him just before dusk, and a helicopter descended on the beach. Half an hour later he was at Goose Bay.

After Ritchie had left the tanker, Schilling had come in again and this time all his tanks filled, except the one defective forward auxiliary. Then he, too, was off westward through the stratospheric jet-stream. He passed Goose Bay at 41,000ft, and at his highest reached 44,000. As he began to let down for Limestone on the radio compass, he heard on R/T. that Ritchie was safe. He landed at Limestone 10 hr 2 min after leaving Manston.

* * *

Measured as a pioneer effort it was a great flight. It showed what can be done to move fighters across the oceans and the continents as a strategic military transfer. It indicated that the Atlantic crossing should have four tanker bases, in Scotland, Iceland, Greenland and Labrador. And it emphasized the need for thorough ground and air drill. Moreover, the ground controller system should be enlarged, with power to order pilots to land at intermediate airfields if considered necessary.

Such an organization would most readily be assured by setting up a flight refuelling group in Transport Command. The group would have control of the tanker fleet, and would have trained ground-control officers to supervise the operation of the long-range flight-refuelled journeys throughout the various stage-lengths. When operating over the Atlantic the British group would work in co-operation with whatever organization the Americans decided to establish for the same purpose.

It should be the task of such a group to get the combat aircraft of operational groups from base to operational fields anywhere in the minimum time by means of flight refuelling along the routes concerned. With such a regular organization the passage of the Atlantic could be developed into just a routine. And if that were done as a military project, it seems certain that afterwards it would be succeeded by a civil passenger flight-refuelled organization, able to raise the payload into regions impossible to attain by aircraft compelled to lift a full fuel-load for their through journeys

AN AVRO-CANADA APPOINTMENT

FROM Avro-Canada, Ltd., comes news of the appointment of Mr. Thomas S. McCrae—an American, and an engine specialist of long experience—as general manager of the company's gas-turbine division, now busy on production of the over-6,000 lb-thrust Orenda. Mr. McCrae is from the Allison Division of the General Motors Corporation in Indianapolis, Indiana, where he has been assistant director of engineering since January of 1947. He joined Allison in 1936 and at first did installation and contact work with the U.S. Army Air Force and with aircraft constructors. He became assistant chief engineer in 1939. In 1944, just before the invasion of Europe by the Allies, General James Doolittle, of the U.S.A.F., invited him to England for consultation on the operation of Allison engines, principally in Lockheed P-38s.

Mr. McCrae.

Previous to his work with Allison, Mr. McCrae was with the research division of General Motors in Detroit, and for six months worked for Buick. He joined General Motors in 1931 on his return from a trip to Japan and China, where he had gone in the previous year to consult on Wright and Curtiss engines. He had joined the Curtiss Airplane and Motor Co. in Buffalo in 1925, and worked on the development of the Curtis D-12 Conqueror, Super-Conqueror, Challenger and Chieftain engines.

FORTY YEARS OF FINISHES

IN 1911, the late Mr. A. J. A. Wallace Barr was taking part in a hockey match at Richmond, Surrey, when he was approached by a friend with the suggestion that they should go into partnership in a business to manufacture cellulose acetate. Thus was born the firm of Cellon, Ltd., now world-renowned as manufacturers of aircraft and other cellulose finishes. The story was told on November 23rd, when the company celebrated its fortieth anniversary with a dinner at the Castle Hotel, Richmond, to which all employees with 15 or more years' service were invited.

U.S. DELIVERY LAG RECENTLY

THAT "two-year-old, multi-billion-dollar" appropriations had not yet brought about any considerable increase in America's fighter and bomber strength was admitted by a Defence Department spokesman in Washington.

He said that the Department had had to lengthen the time allowed between the granting of authority for buying certain types and their delivery from the production line; fighters which originally required 18 months now needed 24, and bombers such as the B-47 took 32 months to appear instead of 24.

The Washington report gives no information as to whether the official attempted to explain this lag; it does, however, quote him as saying that "Foreign air forces are getting American-built aircraft, under the aid programme, before the U.S. Air Force".

HERE AND THERE

DANISH A.O.P.: One of the first air-to-air views of the KZ-10 air observation post, built by Skandinavisk Aero Industri A/S and lately demonstrated with success in Switzerland. Twelve are being acquired for the Royal Danish Artillery and substantial Swiss orders are expected.

Dassault Delta

A DESIGN-STUDY is in hand at the Marcel Dassault works for a delta-wing fighter capable of attaining a Mach number of 1.5. The designation Dassault 550 is reported.

Tory Civil Aviation Committee

NAMES of officers of the Conservative Party's Civil Aviation Committee were recently announced. They are: The Hon. George Ward, M.P., chairman; A. Cdre. A. V. Harvey, C.B.E., M.P., vice-chairman; The Hon. John Grimston, M.P., and Mr. W. R. D. Perkins, M.P., hon. secretaries. A. Cdre. Harvey is also a vice-chairman of the Defence Committee.

Furies in a Hurry

TWO Hawker Sea Furies on a routine delivery flight to the Mediterranean on November 27th made an unofficial record by covering the 1,322 miles between Lee-on-Solent and Malta in 3 hr 22 min, an average speed of 393 m.p.h. Flown by Lts. J. R. S. Overbury and D. B. Law, and with a useful tail-wind, they reduced the Navy's previous best time by 1 min 21 sec. Within two hours, however, the "record" was lowered again, when two other Sea Furies, piloted by Lts. P. N. Parashar and T. Chakravarti, reached Malta in 3 hr 11 min (415 m.p.h.). These two officers, and Lt. Law, are members of the Indian Navy.

More Norwegian Aluminium

UNDERTAKINGS to be financed from £12½ million of Norway's £27¼ million budget surplus include a big new aluminium plant at Sunndalsora.

Missile Liaison

NOW at Cocoa, Florida, is G/C. N. C. S. Rutter, C.B.E., who has arrived to take up his duties as liaison officer with Maj.-Gen. William L. Richardson, U.S.A.F., commander of the guided-missile range there.

Wolverhampton Developments

PROPOSALS including the increased payment by Boulton Paul Aircraft, Ltd., towards the maintenance expenses of Wolverhampton Airport, and the sale by the Corporation to Boulton Paul of nearly 11 acres of land adjoining the companys' factory at Pendeford, has been approved by the Wolverhampton Town Council. The airport is also used by the Wolverhampton Aero Club, whose owners, Air Schools, Ltd., operate it for the municipality. It is said that the existing area of 90 acres could, if necessary, be almost doubled.

CLAMBERING SWERVE: Tangential departure of a Martin XB-51 light bomber from the maker's airfield at Baltimore, Maryland. There is no mention, in the caption supplied with the picture, of rocket-assisted take-off, though provision for Jato rockets is made on the rear fuselage sides. The dense smoke-trail may well be accounted for by the three turbojets, though, as will be observed, at the moment the photograph was taken only the unit installed in the fuselage tail was emitting smoke.

Amendment

COLONEL FINN LAMBRECHTS has been appointed Commander-in-Chief of the Norwegian Air Force, and not of another Scandinavian force as recently reported in these columns.

Reminder

THE Royal Aeronautical Society's lecture on December 20th ("Control Surface Flutter," by E. G. Broadbent and W. T. Kirkby) is to be held in the lecture theatre of the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1, instead of at the usual venue, the Institution of Civil Engineers.

N.Z. Race News

THE U.S.A.F. has accepted an invitation to enter aircraft for the London to New Zealand Air Race in October 1953, announces Mr. Thomas Finletter, U.S. Air Secretary. Mr. Hume Christie, president of the Royal New Zealand Aero Club, and Mr. John Stannage, a Christchurch businessman, recently visited Washington to extend the invitation.

Japanese Helicopters

THE former Kawanishi Aircraft Company of Nishikamiya city, Osaka, is now known as the Shinmeiwa Industry Company and is expected to conclude, before the year's end, a contract with the Bell Aircraft Company for the manufacture of helicopters. Mr. Frank Kelly, assistant vice-president of the Bell company, recently inspected the plant at Osaka.

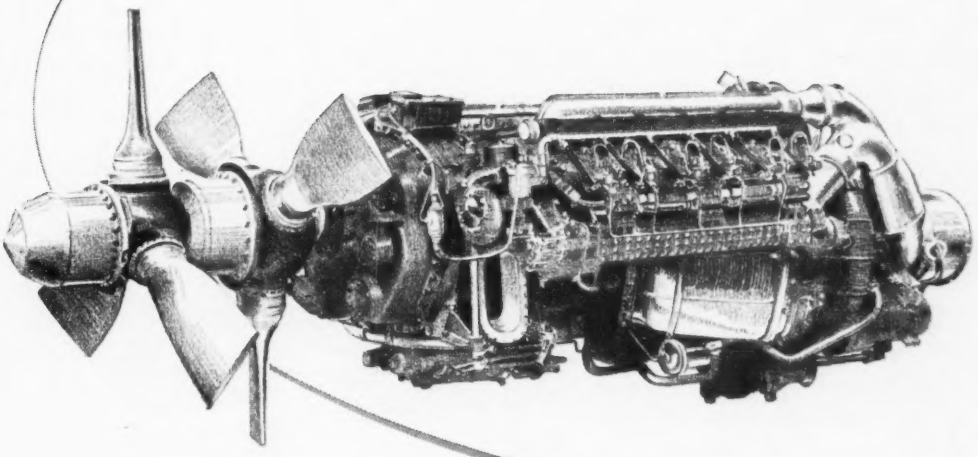
Rolls-Royce in Scotland

CONTRACTS for the construction of the £2,000,000 factory at East Kilbride, to be used by Rolls-Royce, Ltd., for Avon production, have been secured by a number of Scottish firms. The major contract is described as "one of the most important entrusted to a Scottish firm for several years," and the firm concerned has already started building operations on the East Kilbride site.

It Probably Proves Something

RECENT reports from South America suggest that Argentinian private pilots are now spending much of their flying time inverted. Two months ago an instructor claimed to have made 1,090 consecutive loops in a Piper Cub; on November 8th a woman pilot achieved 862; and on November 27th another, Señorita Segado, flying a Piper 43, looped 963 times (and she had only taken her licence on June 7th). "When you approach a thousand loops," her instructor is quoted as saying, "the important question is no longer physical stability, but fuel supplies."

NAPIER NOMAD



Nomad — the first composite gas turbine/piston engine, is Britain's newest contribution to aircraft propulsion. A 3,000 h.p. engine with a standard of operating economy hitherto unachieved, it follows classic Napier designs whose names are prominent in the story of British achievement in the air.

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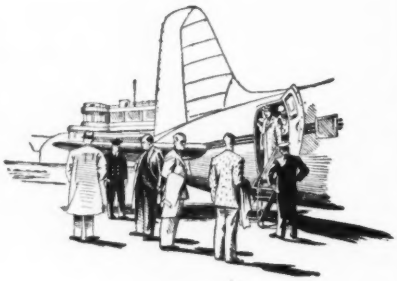

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TRANSONIC PROBLEMS

Mr. A. N. Clifton's Lecture Before the Royal Aeronautical Society

AS noted briefly in our last week's issue, a Royal Aeronautical Society "main" lecture was given at Cheltenham, on November 22nd, by Mr. A. N. Clifton, B.Sc., F.R.Ae.S., the title of the paper being "Problems of Transonic Flight". Mr. Clifton is assistant chief designer, Vickers-Armstrongs (Supermarine), Ltd.

The lecturer started by observing that, whilst everyone was familiar with diagrams plotting the increase of drag coefficient against Mach number, to the aircraft designer the drag, not the drag coefficient, was the important thing. Thinness and sweepback involved considerable increase in area, but the price was worth paying for, at a Mach number of 1.3, it would be an achievement to keep the drag increase down to 20 times that of equivalent straight wings at $M = 0.7$.

To some extent, the same thing applied to fuselages, and it could be shown that, for a fixed frontal area, increasing the body length, i.e., increasing the fineness ratio, resulted at subsonic speeds in an increase in drag whereas, at supersonic speeds, the drag was (relatively) greatly reduced. Mr. Clifton illustrated that, by doubling the fineness ratio from 5.5 to 11, the drag at speeds $M = 1.2$, 1.3 and 1.4, could be halved.

Points on the importance of surface finish, both in terms of roughness and waviness, were then touched on, after which the lecturer commented on the well-known need for large increases of thrust for transonic flight. No complaints could be made about the rate of development of the turbojet but, nevertheless, the thrust increases required were tremendous. A great problem was the provision of a suitable intake, and knowledge of transonic efficiency in this context was lacking. There was, in fact, some evidence indicating an unpleasant drop in pressure recovery at the entry round about $M = 1$. Again, where to put the intake remained a burning question.

On the score of stability and control, Mr. Clifton illustrated (Fig. 1) an estimate of the variation of aerodynamic centre with Mach number for two wings, one straight and the other swept back 45 deg at quarter chord. The lower line on each graph indicated the effect of deleting the tail. Considering elevator angles necessary, with a fixed tail, to overcome the out-of-balance moments, Fig. 2 gave these angles for the swept wing aircraft at 40,000ft and also at 5,000ft. It would be realized that these estimates applied to a given tail setting, in this instance 0 deg relative to datum. If, however, the tail setting were changed by 1 deg to −1 deg in order to reduce the elevator angles, a disproportionate improvement resulted.

These curves were calculations, and a word or two was necessary about the method used for assessing distortion effects. In Fig. 3 was shown the variation of $A_1 (= \delta C_L/\delta\alpha)$ and $A_2 (= \delta C_L/\delta\eta)$ —where α was tailplane incidence and η was elevator deflection—which had been used in the evaluation of elevator effect. Whereas the change of lift with incidence on the fixed surface improved with increasing M, the opposite was true of the moving surface. In Fig. 4 was shown the rearward shift of the centre of pressure of tailplane lift A_1 and elevator lift A_2 as M was increased, and the effects of these factors upon elevator effectiveness were shown in Fig. 5. The calculations were based on strip theory, and the mode of distortion was chosen at the start and only the magnitude was allowed to vary. The theory, like all theories, had its limitations, but the curves did show the type of thing which was liable to happen.

When the structural stiffness had been dealt with as far as possible, the elevator was still in all probability rather ineffective, and the forces large for the pilot to hold, bearing in mind the rather rapid changes of trim which could occur under transonic conditions. This raised the subject of fore-and-aft control as distinct from trim. Even on a rigid aeroplane, the stick force per g would increase considerably at high Mach number, due to the shift of the wing aerodynamic centre alone. When the loss of elevator effectiveness both from aerodynamic and structural causes was added, the result was a very large increase, which certainly required spring tab or power aids in order to give satisfactory forces. The situation was improved if it was decided to use the tail for trimming, because an elevator of similar chord could then be used.

Before leaving fore-and-aft characteristics, the lecturer went on, mention might be made of the tendency of swept wings to become longitudinally unstable at large incidence, as a result of loss of lift at the wing tips. This feature occurred at a progressively lower lift coefficient as Mach number was increased. The result, in flight, was that in tight turns the stick force per g tended to zero, or even became negative as M was increased, particularly at altitude. This could prevent full utilization of lift for manœuvring purposes, depending upon how far control could be maintained in the unstable condition. Again depending upon controllability in the unstable condition, there was a possible danger of breaking the aircraft by applying high g unintentionally.

Turning to consideration of lateral control, Mr. Clifton stated that there was a familiar problem, aileron reversal, which was similar in nature to the problem of retaining elevator effectiveness. On a swept-wing aircraft, the aileron reversal case might well fix the weight of the torsional material, and also any bending material which was swept back, as opposed to the bending material straight across the centre-section. In designing to provide satisfactory characteristics on transonic aircraft, particularly for control and stability, there was a lack of full-scale data and information with which to check calculations. It was this absence of factual data which was forcing designers to increased weight and to the greater complexity of powered controls and variable-incidence surfaces. Such devices should not be accepted as permanent. They might be only a symptom of our present ignorance.

Mr. Clifton then went on to consider some temperature effects which were not previously important, but which became apparent at transonic speeds. In Fig. 6 was shown the well-known temperature rise due to velocity ram plotted against M at sea level in the tropics. The probable aircraft skin temperature rise was assumed to be 85 per cent of the theoretical, and was also shown. Skin temperatures due to this effect of the order of 100 deg C would arise at about $M = 1$, low down in the tropics. Two problems arose: firstly structural, especially in relation to plastic com-

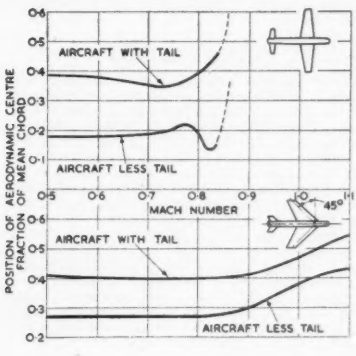

Fig. 1. *(Left) Variation of aerodynamic centre position with Mach number.*

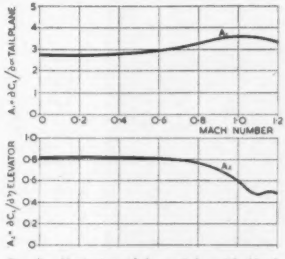

Fig. 3. *Variation of A_1 and A_2 with Mach number.*

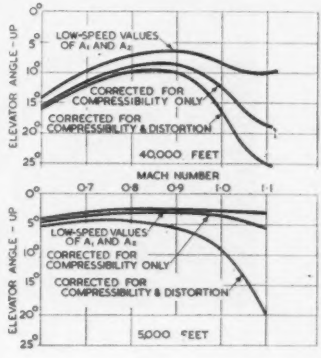
LOW-SPEED VALUES OF A1 AND A2
CORRECTED FOR COMPRESSIBILITY ONLY
CORRECTED FOR COMPRESSIBILITY & DISTORTION
40,000 FEET
MACH NUMBER
ELEVATOR ANGLE - UP
LOW-SPEED VALUES OF A1 AND A2
CORRECTED FOR COMPRESSIBILITY ONLY
CORRECTED FOR COMPRESSIBILITY & DISTORTION
5,000 FEET

Fig. 2. *(Right) Estimated elevator angles to trim for surfaces swept at 45 deg.*

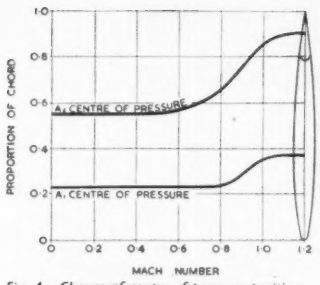

Fig. 4. Change of centre-of-pressure positions with Mach number.

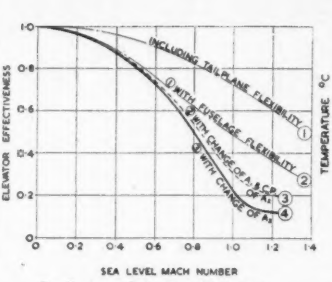

Fig. 5. Loss of elevator effectiveness.

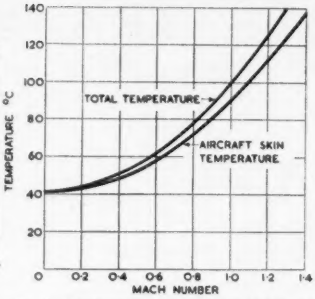

Fig. 6. Temperature due to velocity ram at sea level in tropical summer.

TRANSONIC PROBLEMS . . .

ponents, and secondly mechanical, in providing temperature control apparatus for the pilot and any other temperature-sensitive items.

Canopies almost universally incorporated acrylic resin transparencies, and Fig. 7 illustrated what happened to the bending strength of this material as temperature increased. Fig. 8 showed the tensile strength of unplasticised acrylic resin plotted against temperature of outside surface, and equivalent Mach number derived from the previous curve. For some time, the relationship given by the lower curve had been assumed, and represented the state of affairs when the temperature was uniform through the whole thickness of the material. It was, however, clear that the inner surface with a single-skin canopy would be at some lower temperature, because a cockpit temperature of much more than 30 deg C could not be allowed. The question of the strength of acrylic resin with a temperature gradient across the thickness then arose. It would appear from tests that something like the strength equivalent to the mean temperature applied. On this basis, and if, for example, an inner surface temperature of 30 deg C was taken, the relationship given by the upper curve of Fig. 8 resulted. It was apparent that even with this relief, the present material could hardly be used for single-skin canopies beyond $M = 1.4$ at tropical temperatures and low altitudes. Failing anything else glass windows would have to be fitted for higher speeds. Unfortunately, both acrylic resin and glass were unsatisfactory engineering materials, and something better was badly needed.

Light alloys had rather better properties than acrylic resin, but even so, at 150 deg C there was a substantial loss in strength for bar material and for sheet. In attaining the greatly increased powers needed for transonic flying, there was no doubt that engine temperatures would increase. In the interests of minimum frontal area, clearances between engine and structure were small. A one-inch clearance around an Avon engine added about one square foot, or 10 per cent, to its frontal area. Therefore, clearances were kept to a minimum and air was circulated internally for cooling. When the air entered at about 100 deg C, large quantities would be needed to keep the structure down to, say, 150 deg C,

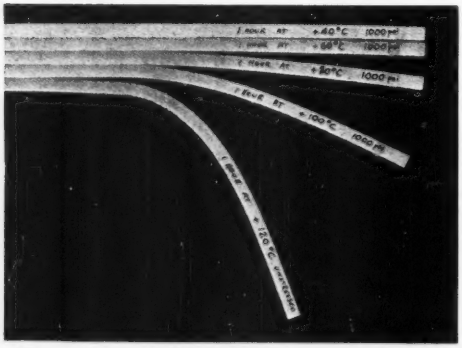

Fig. 7. Bending strength of unplasticised acrylic resin at elevated temperatures.

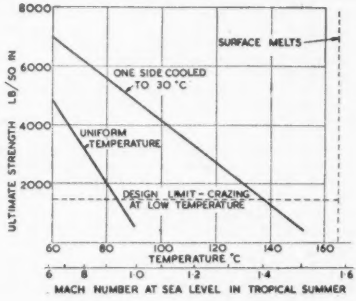
ULTIMATE STRENGTH LB/SQ IN
SURFACE MELTS
ONE SIDE COOLED TO 30 °C
UNIFORM TEMPERATURE
DESIGN LIMIT - CRAZING AT LOW TEMPERATURE
TEMPERATURE °C
MACH NUMBER AT SEA LEVEL IN TROPICAL SUMMER

Fig 8. Tensile strength of unplasticised acrylic resin at elevated temperatures.

and great ingenuity would be needed to avoid a good deal of added drag from this cause.

As soon as the temperature limitation for any item was below, or even near, the stagnation air temperature, apparatus had to be installed to cool the air supply. Under certain conditions, this was already necessary for the pilot, gun ammunition and some radar components. As under other conditions heating and pressurizing were required, complete air-conditioning apparatus had to be installed to maintain temperatures and pressure within the desired limitations.

ROYAL DUTCH SHELL CHANGES

FOR reasons of ill-health, Mr. B. Th. W. van Hasselt has decided to resign at the end of the year from the position of director-general of the Royal Dutch Petroleum Co. For the same reason he has tendered his resignation as a managing director of the operating companies of the Royal Dutch Shell Group.

In view of this move, Mr. L. Schepers has been appointed a managing director of the Anglo-Saxon Petroleum Co., Ltd.; the Shell Petroleum Co., Ltd., and N.V. de Bataafsche Petroleum Maatschappij; these appointments to take effect on January 1st. Mr. Schepers is at present a manager of N. V. de Bataafsche Petroleum Maatschappij.

VITAL COMPLICATION

THAT this country was now spending on radio and radar alone as much money as she was paying for complete aircraft shortly before the war was disclosed by Sir James H. Barnes, K.C.B., K.B.E., Permanent Under-secretary of State for Air, in a speech at R.A.F. Station, Yatesbury, recently. "In one of the new aircraft which will come into the squadrons in the not distant future," he said, "there are no fewer than 25 separate radio and radar sets and no fewer than six different voltages in the aircraft. In some of the new operational aircraft there are hundreds of radio and radar valves. These complicated mechanisms are vital . . . electronic equipment is, in fact, the eyes, the ears and the whole nervous system of the Royal Air Force; without it the force cannot intercept the enemy; it cannot fight and it cannot bomb."

Sir James Barnes was speaking at the passing-out parade of boy entrants of Nos. 2 and 3 Radio Schools, Yatesbury and Compton Bassett. He also took the salute—the first occasion on which a Permanent Under-secretary of State for Air has acted as reviewing officer at an R.A.F. passing-out parade.

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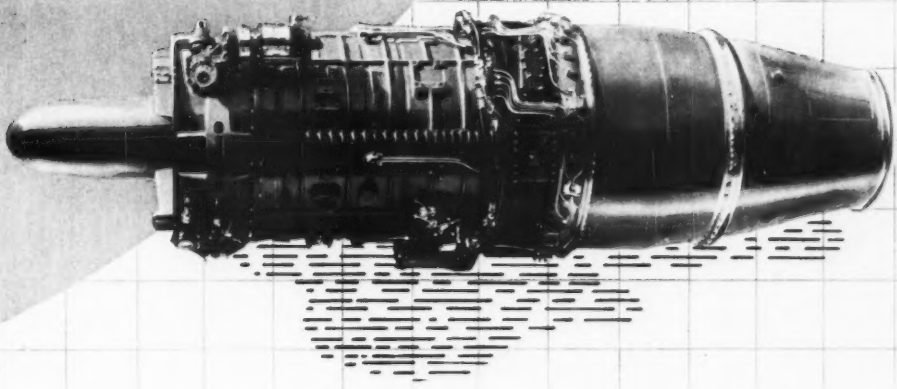

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Versatile Bristol Freighters for R.N.Z.A.F.: Supply-dropping, Casualty Evacuation, Freight and Troop Transport, Aerial Top-dressing.

FROM Abingdon, on November 22nd, the first of a number of Bristol Freighters ordered by the Royal New Zealand Air Force left on the initial stage of its delivery flight. Three similar aircraft are expected to follow this year, and a number of others during 1952.

Of a non-standard model, these Freighters have been developed especially for the R.N.Z.A.F. and are equipped for casualty evacuation, supply-dropping, freight transport, air/sea rescue, and troop transport. In being convertible for aerial top-dressing, they have an eminently useful civil application, and with this in mind three two-ton hoppers, for the controlled dropping of agricultural fertilisers, are being initially supplied. The cockpit differs from standard in that there is no co-pilot's station; instead, accommodation for a navigator has been provided alongside the pilot.

At Filton before the delivery flight of the first R.N.Z.A.F. Freighter are (left to right): F/L. H. N. Burrows (navigator), John Howman (Bristol test pilot, who handled the conversion of the New Zealand crew), F/L. D. Hutton (pilot), and F/L. G. V. Groves (radio officer).

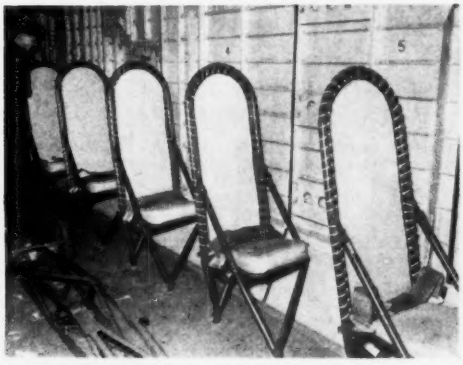
NEW ZEALAND'S CHOICE

For supply-dropping the aircraft have a roller system in the floor of the freight compartment, along which containers are conveyed for dispatch through the port rear door. When the roller belt is installed room is still available for lightweight seats against the walls of the fuselage, and from these troops can control dispatch of the containers.

The following remarkable loading times recorded during trials at a military establishment in this country have recently been disclosed, and provide a striking illustration of the benefits afforded by the nose-opening doors (the times given parenthetically are for unloading): 17-pounder gun, 12 min (5 min); 40 mm Bofors gun, 1¼ min (5 min); 3-ton lorry, 10 min (2 min); caterpillar grader, 30 min (10 min); bull-dozer, 10 min (5 min). These times are the more remarkable in that those for loading include the time allowed for tying down.

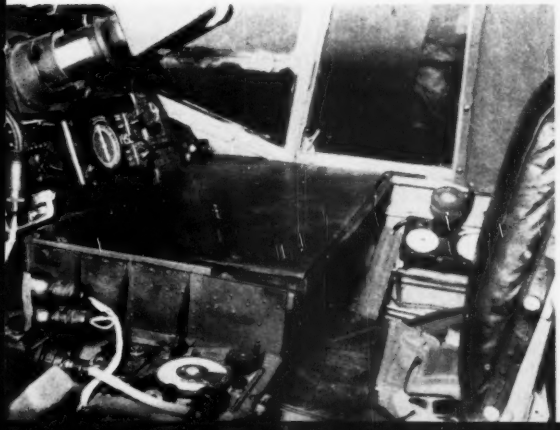
In the troop-transport role the Freighters will accommodate 36 soldiers in rearward-facing seats, which can be readily removed, thus permitting the aircraft to make return flights with casualties or with a full load of military equipment.

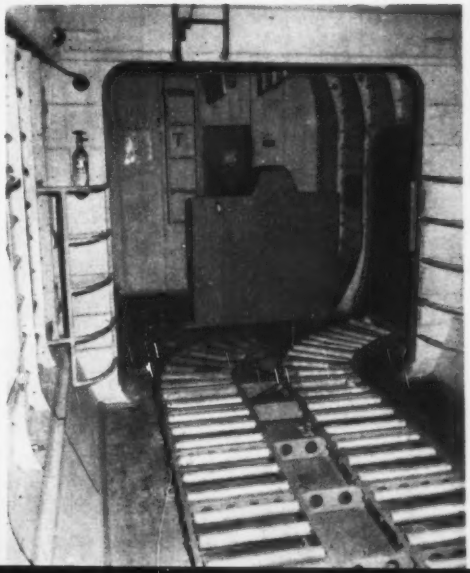
The New Zealand order is the second from a Commonwealth air force to be announced within six weeks; during October it was made known that a quantity of Freighters had been purchased by the Royal Canadian Air Force. Departure of the second of these aircraft incidentally (crewed by Silver City Airways) coincided with the dispatch of the first R.N.Z.A.F. Freighter.

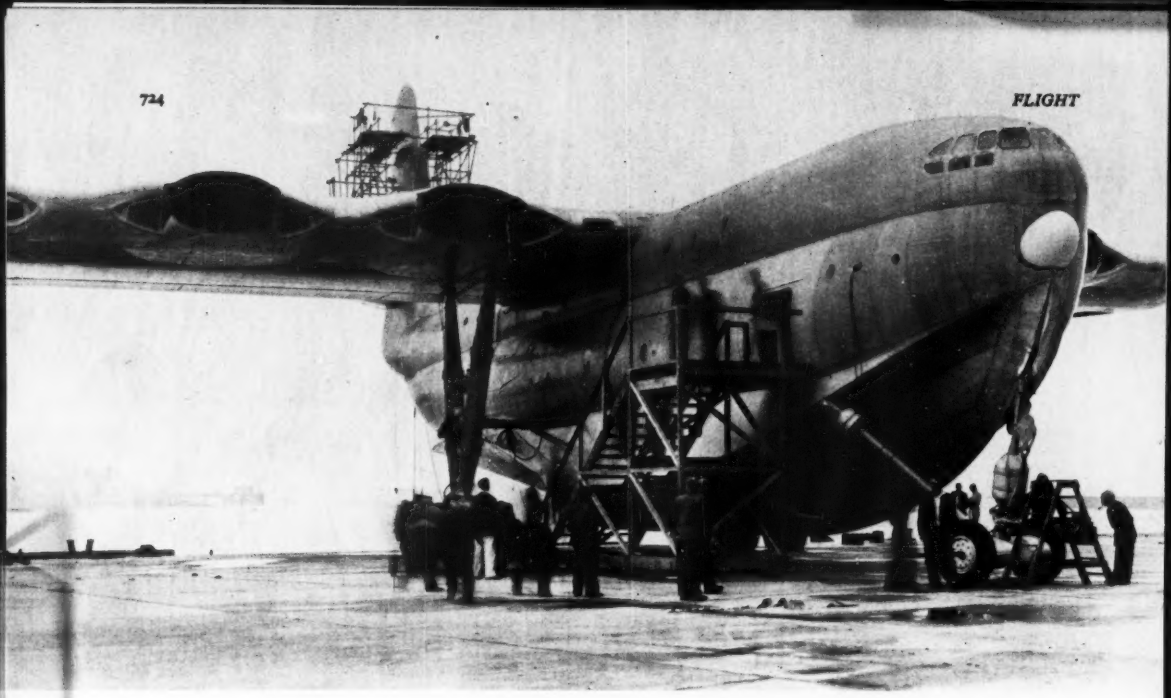


Lightweight rearward-facing seats, 36 of which can be installed.

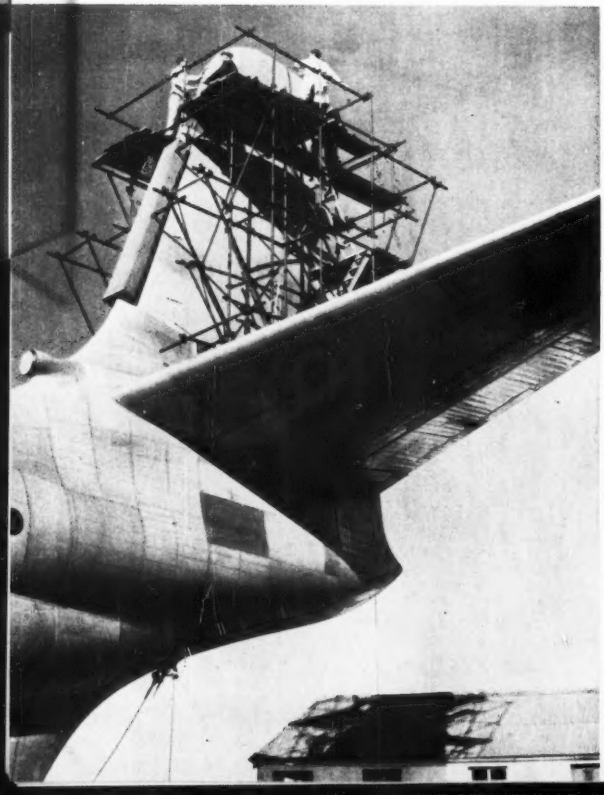
(Below) The roller conveyor belt for supply-dropping, in position in one of the new Freighters. (Below, left) The navigator's station which replaces the co-pilot's seat.







A WINGED SHIP TAKES FORM



The First Princess Flying-boat is now in Launching Position on the Apron at Cowes and the Fin Cap is in Place

SINCE, as recorded in our issue of November 9th, the first Saunders-Roe Princess flying-boat was drawn from the Cowes assembly hangar for the last stages of construction, the fin cap has been added (it is visible in these latest views), and the massive craft has been jockeyed into launching position, with her stern towards the slipway. As will be seen, the outer wings and power plants have yet to be installed, and for the next few months the Princess is likely to be hedged in by another maze of scaffolding. Though still, to some extent, *en déshabillé*, she is, nevertheless, regularly receiving visitors, among whom (as seen below, with Capt. E. D. Clarke, M.C., managing director of Saunders-Roe, Ltd.) was Rear Admiral (E) Hon. Denis Crichton Maxwell, C.B., C.B.E., M.Inst.Mech.E., F.R.S.A.

Preparing for departure from Crewsair's base at Southend Airport.

"Flight" photographs

The Viking at Juba: the outward journey nearly completed.

AFRICAN NOTEBOOK

Part I: A Flight to Entebbe: Uganda's New Airport

By THE EDITOR

IT is a long time since someone first unkindly remarked, "If you've time to spare, go by air"; but even to-day travellers occasionally echo this sentiment, for, in spite of the advances that have been made, there are still times when weather, unserviceability and international uncertainties cause delays and cancellations. On such occasions (as an airline captain implied in *Flight* last week) the reactions of the travelling public may range from the infuriated to the forgiving, in direct ratio to the psychological understanding of individual cases shown by crews and airport staffs. In Africa, as will become apparent later in these notes, conditions are sometimes comparatively primitive and delays may be longer; and in such cases, the original statement might well continue "If time is no object at all it is worth trying another form of transport, although walking may still be the surest way of getting there eventually."

However, it is the intention here to set out by air, making a rather late start from Southend Airport and bearing in mind that only with the aid of an aircraft can Malta be reached in a day. When travelling to and from Africa on previous occasions I have either flown in four-engined luxury with B.O.A.C. or in the more rugged get-up-the-day-before and press-on-regardless atmosphere associated with Transport Command. This time, for the journey to East Africa, my person in company with others was entrusted to a small independent operator, Crewsair, Ltd., who had detailed a Viking and crew of six for the purpose.

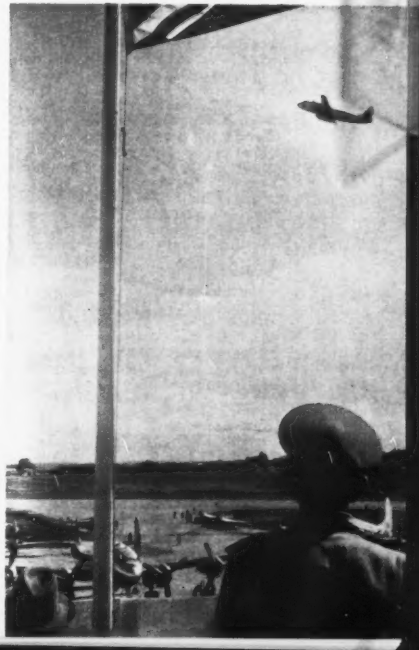
The party left the sordidity of King's Cross by coach at an early hour and duly arrived at Southend. A tyre-burst on the way caused no delay in departure, for the aircraft was not ready and the engine of the refuelling tender would not start. After about four hours' waiting, which everyone resented to a degree directly proportional to the length of time during which he or she was not told why, the Viking took smoothly to the air on a bright, crisp afternoon with a many-knot headwind predicted and realized for the first few hours. Why cannot passengers be told the reasons for delays? In this case the reasons were apparently threefold and, as it turned out, concerned not so much the aircraft but the problems of route and night-stop accommodation occasioned by Egyptian perversity. The operators had, it seemed, been the subject of undeserved criticism.

Let it not be thought that Crewsair is the only company to offend over this matter. In the passenger lounges of the world's airports countless travellers must have cooled their heels while their tempers warmed—all because they had not been told what was, or was not, going on.

It was the first time that most of the party had flown for a long distance in a Viking, and for one or two it was an initiation into air travel of any kind. The first stop was made at Nice, and even so early in the journey the general opinion had been formed that the aircraft was a comfortable and pleasant one in which to fly. The crew, including two stewards, went about their jobs in a competent and business-like manner which in turn instilled confidence into the passengers. At airfields all down the line we were received, escorted to the lounge and fed just as if we had stepped from the flagship of a regular airline. The crew was headed by Captain Fox and First Officer Hand.

To avoid night-stop difficulties further down the line a few additional hours were spent at Malta

(Below) *The compact Customs department in Entebbe's new airport building. The internal layout of the terminal is commendable.*



"Flight" photograph

Air Commodore Pankhurst watches the Viscount's spectacular demonstration take-off and climb at Entebbe. Both were paying a brief visit from Nairobi, where the air commodore is A.O.C. East Africa.

A less familiar view of Entebbe's long runway, stretching almost from shore to shore across the headland. The taxi-loop depicted is at the north-west end. In the background may be distinguished the Government hostel and on the left-hand side is the Lake Victoria Hotel.

Weather information received by radio is recorded by African staff recruited in nearby Kampala. Their names are Eric Wabomba (left) and Daniel Nasade.

AFRICAN NOTEBOOK . . .

—a welcome decision to everyone who wished both to sleep and also to see something of that delightful island, usually sun-baked, but at this time having experienced more rain in the preceding six weeks than in a normal year.

Once away from Malta the plan provided for a through flight all the way to Entebbe in Uganda without any stops other than those required for refuelling. Brief halts were made at El Adem, Wadi Halfa, Wadi Saidna and Juba. At El Adem I talked to Transport Command crews engaged in shuttling troops to the Canal Zone. They spoke highly of their Mk 2 Hastings, which, it seems, show a great improvement over the earlier models. Reference has already been made in *Flight* to the differences, which include mods to tail, engines, and controls. What a depressing place, by the way, is the El Adem transit mess !

The Wadis were seen only by night : Wadi Saidna is an alternative to Khartoum, which we were told was closed for night flying while runway repairs were in hand. With the speed that surprises a European, dawn burst over the land as it does in tropical countries, and we were able to see the confluence of the Niles as we climbed away from Wadi Saidna.

At Juba we overtook the Vampires, Mosquitoes and Valettas of a "task force" investigating the possibilities of jet reinforcement routes between the Cape and the Canal Zone. The jets, which created quite a stir among the natives, apparently had little trouble in flying from Juba's not-too-good runway, for we were to find them all safely at Entebbe when we landed there an hour or two later. I have seen newer-looking Vampires in my time, but no doubt the life of an aircraft and its engine is, in Africa, a hard one.

I have been wondering what effect a wild pig might have upon a Viking if the two came into contact during take-off. Fortunately, perhaps, we just missed the specimen that raced across the Juba runway as we departed. On the last short leg to Entebbe the captain

"Flight" photograph

Vampires refuel at the kerosene pumps installed especially for the Comets which are expected to call at Entebbe. Note the Ethiopian Convair 240 (which carries a dazzling colour scheme) and the airport name marked on the hill in the background.

flew low enough for us to distinguish herds of elephant and an occasional hippo on the river banks.

The party received a warm welcome, formalities were quickly coped with, and our incognito V.I.P. was whisked away to Government House. The rest of us were provided with transport and soon accommodated either at the Lake Victoria Hotel or with one or other of the various residents who had offered hospitality.

Entebbe's Airport

Entebbe's opening day was undoubtedly a success : as *Flight* reported on November 23rd (pages 650-651), the weather was perfect and all went according to plan. By home standards, at least, the official speeches were too long, and a good deal of what was said would have been better printed in the programme.

The Viscount made a great impression on everyone and it was a matter of regret to the Vickers crew that a visit could only just be squeezed in between other commitments on that day. As a result they could not accept the ready Entebbe hospitality and had to take off for Nairobi as the Vampires started their display, which was Event No. 2 in the programme.

At that time, the Viscount was nearing the end of its tropical trials, which have taken it to various airfields in North, Central and South Africa. Mr. George Lowdell told me that the tests had been particularly successful and the Darts are behaving very well. Fuel consumption figures have been appreciably below expectations. An announcement in the East African papers that the Viscount would be delayed at Nairobi by lack of methanol led some people to believe that it was unable to operate from high-altitude fields without it. This, of course, was quite wrong, as was forcefully demonstrated when the aircraft later made a trial take-off from Nairobi on three engines only. In fact, supplies of methanol had been held up by the troubles in the Canal Zone, and one of the few remaining series of tests which the Viscount had to make before returning to England entailed take-off with water methanol injection.

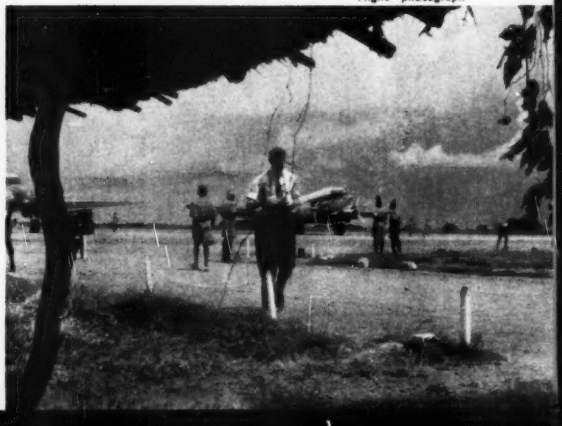
The flying programme at Entebbe's opening might well have been extended by the addition of one or two light-aircraft demonstrations, but both the Ethiopian Convair and E.A.A.C. Lodestar gave lively performances. Those who saw the Convair's rocket-assisted take-off agreed that it did not give a very spectacular impression, nor was it one likely to alarm the passengers. It is possible that if more people saw and experienced Jato, other companies would find ways of taking advantage of such assistance.

The efforts of the Vampire team were greatly appreciated, and the response of the thousands of Africans to the first fast run was remarkable—a tremendous babbling on all sides, followed by spontaneous cheers.

The large number of official guests at Entebbe were treated to most interesting excursions during their stay, and all enjoyed

The Viking and a Tropic Airways Dakota viewed from the shadow of the "passenger lounge" at Juba.

"Flight" photograph



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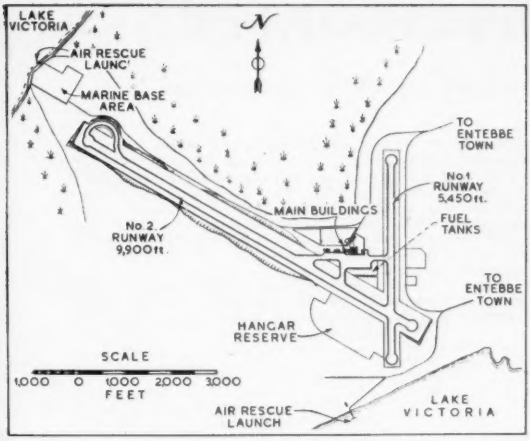


Entebbe in plan form. The areas reserved for the marine base and hangarage are as yet undeveloped, and fuel installations are not in their final form. The large apron is now almost finished.

AFRICAN NOTEBOOK . . .

exceptional kindness and hospitality from residents nearby and in Kampala. Transport arrangements, so often a difficulty, were laid on admirably by Mr. F. J. Hopgood. A friendly airport staff (under the manager, Mr. H. L. Dawson) and Mr. Basil Clarke (who, with a team of men and girl assistants, organized the opening ceremony) were also accorded well-deserved thanks and praise all round.

In Nairobi, Entebbe's airport is the subject of envy, in particular because the site was relatively easy to turn into a good airfield. This observation does not detract in any way from the enterprise and courage of those who planned and went ahead with construction. The low cost-figure gives an indication that no unexpected setbacks or difficulties occurred. Nairobi is still in the process of grappling with its own airfield problems, as will be explained in a subsequent article.

The airport buildings are most attractive and more than adequate for the present traffic, which comprises either a B.O.A.C. Hermes or Air France Constellation on most days, a regular daily E.A.A.C. machine, eight Sabena services a month, and some charter aircraft and diversions. If main-line traffic builds up, the Customs set-up would probably be hard-pressed to deal with a couple of airliners at once. Catering would be able to cope, and the toilet and washing arrangements are excellent. Compared with the met. section, which has a most generous allocation of space, flying control and associated departments seem to have taken almost a back seat.

Power failures are not unknown in the Entebbe area any more than at Nairobi or in London, so the authorities have done well to provide Entebbe Airport with an independent fully-automatic emergency generating set. The runway lighting is now temporary, but a permanent G.E.C. installation should be in use early next year, together with low-intensity approach lighting.

Aids and equipment include M/F. locator beacons at runway ends, flashing beacon, cloud searchlight and, to come, V.H.F./D.F. (on the nearby hill) and teleprinter to Nairobi. A public-address system (with radio and gramophone) is installed. There will also be £3,000 worth of Decca thunderstorm-warning radar. It is to be a more or less standard collision and cloud-warning set with the wavelength altered for precipitation; ranges will be 120, 60 and 10 miles. It was something of a surprise, incidentally, to find one storeroom already stocked with some Comet spares.

Entebbe is very Comet-conscious, and preparations are well ahead to receive these jet airliners. Kerosine installations, storm radar and a taxi-loop at the runway end (as proposed by Sir Frank Whittle) are examples, and the quite elaborate met. section has been set up largely as a result of the new requirements of high-altitude high-speed aircraft. African communication systems will have to be overhauled unless, for example, the Comet is to arrive before its own departure signal. The met. set-up and the difficulties of high-altitude forecasting in East Africa are to be the subject of an article in a subsequent issue.

(*To be continued*)

THE V.C.A.S. ON AIR MASTERY

AT a dinner given by the Air League of the British Empire at the Royal West of England Academy, Bristol, on November 28th, Air Chief Marshal the Hon. Sir Ralph A. Cochrane, G.B.E., K.C.B., A.F.C., Vice-Chief of the Air Staff, recalled after the first world war reading a book written by the late F. S. Barnwell, of the Bristol Aeroplane Company, called *The Aeroplane Speaks*. [In this Sir Ralph appears to have erred, for the book in question was the work of Mr. Horatio Barber—Ed.]. To-day, said Sir Ralph, the aeroplane still spoke, but with an emphasis so powerful that no country and no citizen could ignore its message. In less than fifty years it had developed to a stage where we were able to visualize the full and beneficial use of what Sir George Cayley, writing as long ago as 1809, called "the uninterrupted navigable ocean that reaches to the threshold of every man's door." We were approaching the age of air transport and should be able to look forward confidently to the future, were it not for the cleavage between East and West which overshadowed our whole way of life. The East, he said, disposed of very great military and air power which, if used against this country, might cause us mortal harm.

As members of the North Atlantic Treaty Organization we were pledged to aid the countries of Western Europe, and that called for considerable air forces as well as land forces. Memories of the campaigns of 1940, and of those in Greece and Crete, were too recent and too vivid to make it likely that we should forget the importance of the air battle as an essential element in the strategy of a land campaign. Moreover, aircraft also had to be found for the Middle East and to meet the demands of the Dominions and of our allies. The overall requirements for aircraft added up to a considerable bid on the available national resources, yet Sir Ralph suggested that very careful thought would have to be given before deciding not to meet them. As Mr. Churchill had said in his speech at Boston, "For good or ill, air mastery is to-day the supreme expression of military power. . . ."

In preparing to achieve mastery of the air with our allies, said Sir Ralph, we still had within our national character a willingness to face the unknown in the spirit which actuated the Merchant Venturers of the great city of Bristol; this only waited to be brought out, and that, as he understood it, was the purpose of the Air League and the motive behind the organization of flying clubs and all the local enthusiasms which they engendered.

Air power, if it was to be permanent, must be broad-based on commerce; and it must be wielded by an air force in the building of which our first thought must be for quality.

But if we were to meet the perils of the day we needed more rapid production. We must build up our industry immediately, because we must rearm, but, in the long term, because we sought to create a home and overseas trade comparable with our shipping industry. In the matter of men the air force was being well served both in numbers and in quality, whether by the regulars or by those doing their National Service. The aircrew were leading this great new development, and on them the main burden must inevitably fall.

In conclusion Sir Ralph added, "Let us determine two things: firstly that the air over these islands shall never again be sullied by hostile aircraft—that is not a boast, such as Goering foolishly proclaimed, but rather a dedication to do something which no one can yet say with certainty how it will be done, or even that it can be done. And secondly, let us determine by every means in our power to develop the commerce of the air so that this country may take its place once again in the forefront of progress."

Air Chief Marshal Sir Guy Garrod, G.B.E., K.C.B., M.C., D.F.C., M.A., F.R.Ae.S., chairman of the Air League, said that the good name of British airways was suffering because of the Postmaster General's failure to pay the internationally agreed rate to B.O.A.C. for the carriage of air mail. Sir Guy welcomed the decision to pay what he described as "something like a fair rate," but added that the rate was still far short of that internationally agreed. Losses—more apparent than real—were being artificially augmented by the failure of the Postmaster General to pay the fair rate for the work done. Difficulties had arisen, added Sir Guy, because of the non-commercial routes which it had been necessary to operate at the request of the Government.

Sir Guy advanced the claim that the Air League first drew attention to the menace of Russian air power and that it had helped to speed production of the Valiant bomber and the latest types of swept-wing fighter.

THE GIANT HELICOPTER

Part II: An Examination of Performance and Power Installations

LAST week we gave an abstract of the first half of a lecture, "The Giant Helicopter," delivered by Mr. O. L. L. Fitzwilliams, B.A., before the Helicopter Association of Great Britain on November 23rd. In the first section of his paper, Mr. Fitzwilliams confined himself to a statement of the general design parameters concerning ultra-large helicopters; in the concluding part, a digest of which is given here, specific design values are examined.

THE lecturer went on to suggest that, in order to visualize the problems involved in the development of the (giant) helicopters, it was convenient to elaborate the second of the examples he had quoted in the first half of his paper.

This helicopter was assumed to be powered by six suitably modified Adder turbojets and, in common with the others, it had a three-blade rotor of 0.114 solidity and a disc loading of 6.5 lb/sq ft. The rotor diameter would be 102ft, and the machine should have a top speed of 120 m.p.h. at normal loading. The Adders exerted a combined static thrust of 6,300 lb, corresponding to a combined operating thrust of 5,360 lb at the tip speed of 550ft/sec. As a result of the Adder's characteristics, the thrust was substantially constant over the range of relative air speeds experienced by the advancing and retreating blade tips in forward flight, as was shown in Fig. 8.

From the given rotor size and disc loading it followed that the normal gross weight of the helicopter was 53,000 lb and, by applying the assumptions previously detailed, the weight analysis given in Table II resulted.

TABLE II

Jet Transport Helicopter: Six Armstrong Siddeley Adder Turbojets

WEIGHT BREAKDOWN

	lb
Rotor heads	2,020
Tail rotors	200
Fuselage	6,660
Landing gear	2,120
Flight controls	750
Fuel system	1,050
Transmission (tail rotors)	100
Hydraulics	200
Electrics	600
Miscellaneous	750
Total structure (less blades)	14,450
Rotor blades	2,650
Engines and mountings	3,600
Empty weight (lb)	20,700

It would be seen that the normal disposable load might amount to as much as 61 per cent of the gross weight of the helicopter—32,300 lb or, approximately, 14½ tons. The arrangement of the machine was shown in Fig. 9 : it was a simple three-blade single-rotor design with yawing control provided by two tail rotors mounted at the tips of a horizontal stabilizer at the after-end of the fuselage. Large doors and a ramp in the nose of the fuselage enabled wheeled vehicles to be driven into the cabin, whilst passengers entered by a door under the stern of the fuselage. Fuel was carried under the cabin floor in tanks with a total capacity of 2,000 gallons. The crew of three comprised a pilot, co-pilot/navigator and a flight engineer, and the flight deck was in the nose of the fuselage from which the crew could command a good, all-round view.

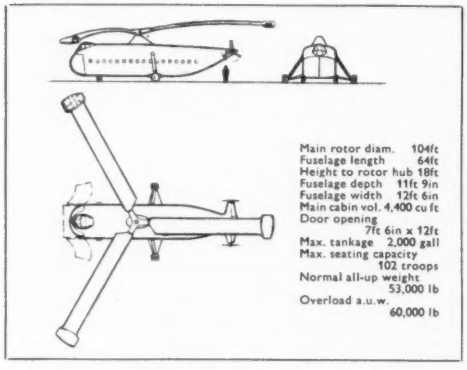

Main rotor diam. 104ft
Fuselage length 64ft
Height to rotor hub 18ft
Fuselage depth 11ft 9in
Fuselage width 12ft 6in
Main cabin vol. 4,400 cu ft
Door opening 7ft 6in x 12ft
Max. tankage 2,000 gall
Max. seating capacity 102 troops
Normal all-up weight 53,000 lb
Overload a.u.w. 60,000 lb

Fig. 9. General arrangement of jet transport helicopter powered by six tip-mounted Adder turbojets.

Details of the rotor articulation and controls were not shown, but, apart from differences in the relative size of the various components, these aspects of rotor design would involve little novelty. To derive an adequate c.g. range, offset flapping hinges would be employed, probably with the centrifugally controlled droop-stops and flapping restrainers which had already become normal practice on small helicopters. Cyclic and collective pitch control were also expected to be in accordance with conventional practice, the control linkage being operated by a duplex hydraulic servo system.

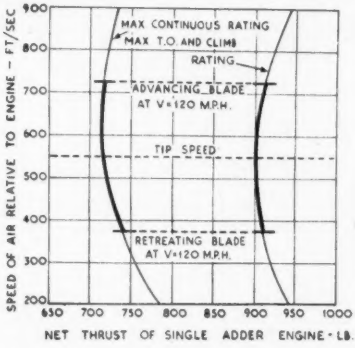
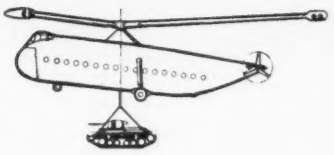


Fig. 8. Performance characteristics, in terms of thrust versus speed, for the Armstrong Siddeley Adder turbojet

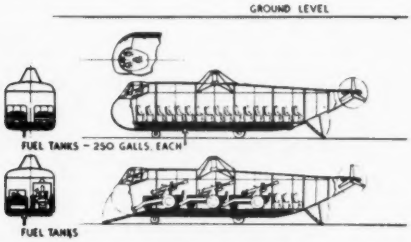
Some novelty was expected in the means of controlling rotor vibrations, and it might be assumed that the blade chordwise balance and trim-tab adjustment would be effected in flight via actuators mounted in the blades and controlled by the flight engineer from the cockpit. The flight engineer would also adjust the angular settings of the individual blades, these functions corresponding with what we now knew as "tracking" and "matching" procedures.

Mr. Fitzwilliams observed that, in these large helicopters, where individual engines might be shut down either voluntarily or as the result of power failure, it would be necessary to provide special means for counteracting such a primary unbalance of the rotor. To some extent, the out-of-balance forces could be counteracted by adjustment of the tracking of the rotor, but an extremely powerful method of balancing was possible by means of a hydraulic system in which a small tank of balance fluid was carried near the tip of each blade, each tank having a pump so that the fluid could be shifted for balancing purposes from one blade to another. By this means it should be possible to balance out the loss of thrust from both engines on a single blade, employing a total weight of hydraulic fluid equivalent to not more than that of one passenger. Even a simultaneous failure of both engines on one blade would not induce vibration of the machine so severe as to prevent the flight engineer from rapidly re-establishing a satisfactory state of balance.

Gyroscopic couples arising from the yawing velocity of the engines in the plane of the rotor, and from cyclic pitching oscillations imposed by the controls, could be entirely isolated from the blades by handing each pair of engines and gearing or synchronizing them together to run at the same speed, but such elaborate precautions were not necessary in view of the robust construction of the blades. The gyroscopic couples resulting from yawing of the engines actually caused only a small, steady increase or decrease of collective pitch, whilst the cyclic pitching gave rise to gyroscopic couples which acted in the plane of the blade and should, therefore, easily be resisted.



HELICOPTER HOVERING IN GROUND CUSHION



Tank or self-propelled-gun transport.—Empty weight, 20,700 lb; crew (pilot, co-pilot/navigator, flight engineer), 600 lb; 15-ton tank, 33,600 lb; fuel (630 gall), 5,100 lb. Overload a.u.w., 60,000 lb.

Troop transport.—Empty weight, 21,860 lb; crew, 600 lb; 102 troops, 18,400 lb; fuel (1,500 gall), 12,140 lb. Normal a.u.w., 53,000 lb.

Artillery transport.—Empty weight, 20,700 lb; crew, 600 lb; three jeeps, 7,050 lb; three x 25-pdr guns, 12,100 lb; 150 rounds ammunition, 5,250 lb; 18 gun crew 3,240 lb; fuel (500 gall), 4,060 lb. Normal a.u.w., 53,000 lb; additional fuel (860 gall), 7,000 lb. Overload a.u.w., 60,000 lb.

Fig. 10. Typical loads for six-Adder transport helicopter.

The lecturer had made some estimates of the likely rigidity of the blades in relation to the gyroscopic couples which would be imposed if both the turbojets at the tip of each blade rotated in the same direction. The results indicated that there would be a steady twist of the blade of not more than about two deg. The gyroscopic couples arising from cyclic pitch change should have a negligible effect on the controls.

Although the weight of the blades was only a small percentage of the gross weight, it nevertheless represented an allowance of approximately 900 lb each, without tip engines. This mass of material suitably applied to the large cross-sectional area of the proportionately rather short blade permitted a structure of great strength and stiffness, which accounted for the small gyroscopic twist and the moderate static droop indicated.

The helicopter would be able to climb vertically outside the ground cushion whilst carrying its normal disposable load of 14.5 tons, and could hover in the ground cushion at a wheel clearance height of 40ft with a disposable load of 17.5 tons. In spite of its large lifting capacity, it would be very compact, with a total fuselage volume little larger than the minimum required to accommodate the loads envisaged. Three typical loads were illustrated in Fig. 10, which showed the helicopter lifting a 15-ton tank whilst carrying fuel for roughly one hour's flight, and achieving with this load a clearance of about 20ft between the tank undercarriage and the ground. In such a case, a cable carrying the weight of the tank would project through the fuselage and be attached direct to the rotor mounting.

The illustration also showed the accommodation which could be provided for 102 lightly-armed troops at 180 lb each, in which case the aircraft at its normal operating weight carried sufficient fuel for a range of 240 miles with suitable fuel reserve. For civil operation, the troop transport rôle illustrated would be applicable to passengers at normal airline weight value. Also illustrated was a typical loading comprising three 25-pdr guns, accompanied by three gun-crews, each of six men, and three towing jeeps, each containing a small allowance of fuel and 50 rounds of ammunition per gun. With this load, the aircraft carried fuel for two hours' flight at a gross weight of 60,000 lb.

Making allowance for reduction in weight during long flights, the ferrying range at maximum continuous power would be 960 miles at the normal gross weight, or 1,100 miles at a take-off weight of 60,000 lb, these figures indicating the ease with which such helicopters could be transferred from one theatre of operations to another. The range/payload characteristics of the aircraft were given in Fig. 11, which made no allowance for reduction of weight in flight. It was shown that the helicopter could transport a military load of ten tons over a distance of 300 miles in three hours, or 15 tons over a distance of 100 miles in one hour.

Mr. Fitzwilliams then went on to consider the characteristics of what he said might be termed a "medium giant" with a rotor approximately 200ft in diameter and powered by single Sapphire turbojets at the tip of each of the three blades. The range/payload characteristics were given in Fig. 12, and the machine would transport a military load of 24 tons over a distance of 500 miles in five hours; 39 tons over 300 miles in three hours; or 54 tons over 100 miles in one hour. The ferrying range at maximum continuous power would be 1,100 miles at a take-off weight of 233,000 lb.

In Fig. 13 was indicated the operating range of the helicopter for various typical loadings such as, for example, 450 troops, or three 15-ton tanks, or six 25-pdr guns, each with its six man gun-crew, towing jeep and ammunition. The illustration also included the sort of mixed load which, in real operations, was always likely to be required at short notice, e.g., 220 troops with six jeeps and, for good measure, an eight-ton trailer with a tractor weighing four tons. Mr. Fitzwilliams observed that he thought it more satisfactory to carry a standard trailer in this way rather than to accept the distortion of aeroplane and helicopter fuselages which seemed to be inseparable from the use of pods as in the Fairchild Packplane and the new Piasecki. For medium journeys, the helicopter could accommodate four of these trailers and still leave room for upwards of 100 troops, which were many more than would be required to manhandle the trailers in and out in the absence of tractors.

The wide fuselage provided two clear parallel gangways with entry ramps at each end, along which wheeled vehicles could be driven without disturbing the central troop stairways. Either or both halves of the middle seating deck could be folded against the fuselage sides, to give clearance for especially tall stores or vehicles. When in use, both halves of this deck were supported by the central stairway structure, which would be removed only on the rare occasions when it might be desirable to carry the maximum concentrated load internally. Such a load, represented typically by a 50-ton Centurion tank, would normally be suspended beneath the helicopter. With this load, and fuel for a flight of 100 miles with reasonable reserves, the helicopter could, whilst hovering in the ground cushion, achieve a clearance of approximately 100ft between the tank undercarriage and the ground. The general arrangement of this helicopter was illustrated in Fig. 14.

The lecturer expressed the hope that the examples he had given, however incomplete in engineering detail, at least presented an understandable picture of the sort of job which might have to be faced in meeting the transport requirements of future armies. The magnitude of the job should not, however, be exaggerated. In point of pure size, for instance, a circle circumscribing the rotors of the already existing and very complicated Air Horse would

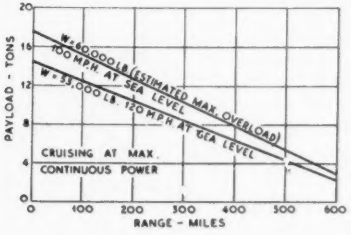

PAYLOAD – TONS
RANGE – MILES
W = 60,000 LB (ESTIMATED MAX. OVERLOAD)
100 M.P.H. AT SEA LEVEL
W = 53,000 LB 120 M.P.H. AT SEA LEVEL
CRUISING AT MAX. CONTINUOUS POWER

Fig. 11. (Left) Payload/range characteristics for six-Adder transport helicopter.

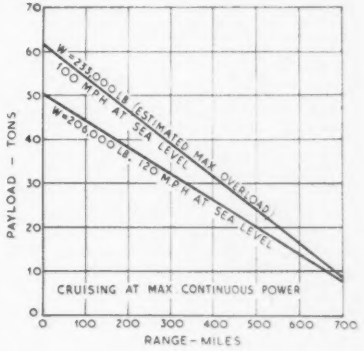
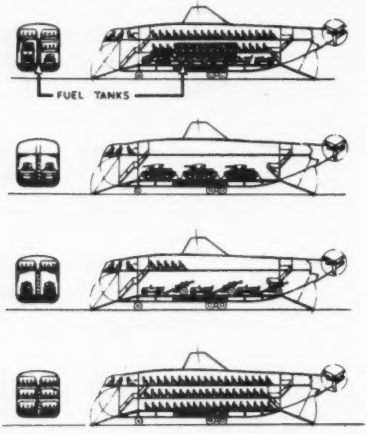

PAYLOAD – TONS
RANGE – MILES
W = 233,000 LB (ESTIMATED MAX. OVERLOAD)
100 M.P.H. AT SEA LEVEL
W = 206,000 LB. 120 M.P.H. AT SEA LEVEL
CRUISING AT MAX CONTINUOUS POWER

Fig. 12. (Right) Payload/range characteristics of three-Sapphire transport helicopter.

THE GIANT HELICOPTER . . .

actually be larger than the much simpler single-rotor of the 100-seat helicopter shown in Fig. 9. Similarly, the overall height and length of the helicopter illustrated in Fig. 14 were not much different from the overall height and length of the new Piasecki already under construction.

Even the largest members of the giant family—helicopters more than half as big again as the medium giant illustrated here—did not, in the lecturer's opinion, seem to present any fundamentally serious constructional difficulties. The type of engineering required differed from that which was necessary for such large, long-range



General utility transport.—Empty weight, 92,000 lb; crew (four), 800 lb; fuel (4,000 gal), 32,100 lb; six jeeps, 14,100 lb; 220 troops, 39,600 lb; one truck or tractor, 9,480 lb; eight-ton container, 17,920 lb. Normal a.u.w., 206,000 lb. Still-air range, 230 miles.

Tank transport.—Empty weight, 90,000 lb; crew, 800 lb; fuel (2,500 gal), 20,000 lb; one x 45- or three x 15-ton tanks,110,800 lb; overload a.u.w., 221,600 lb. Still-air range, 140 miles.

Artillery transport.—Empty weight, 90,000 lb; crew, 800 lb; fuel (4,930 gal), 39,420 lb; six jeeps, 14,100 lb; six x 25-pdr guns, 24,200 lb; 600 rounds ammunition, 21,000 lb; 36 gun crew, 6,480 lb. Normal a.u.w., 206,000 lb. Still-air range, 280 miles.

Troop transport.—Empty weight, 94,500 lb; crew, 800 lb; fuel (3,720 gal), 29,700 lb; 450 troops, 81,000 lb. Normal a.u.w., 206,000 lb. Still-air range, 210 miles.

Fig. 13. Typical loads for three-Sapphire transport helicopter.

aircraft as the Brabazon, for which success or failure in commercial operation depended upon the highest degree of structural refinement. The great lifting capacity of the giant helicopter should, on the contrary, discount excessive refinement and encourage simple, and even crude, constructional methods.

Mr. Fitzwilliams stated that the crux of the problem was obviously the power installation. In his examples, he had assumed turbojets at the blade tips mainly because he believed that this type of power installation offered the best promise of a really versatile and useful solution. In existing circumstances, the choice of an efficient jet system for large helicopters could be narrowed to the tip-mounted turbojet on the one hand and, on the other, two well-known systems in which the blades were used as gas or air ducts.

Both the ducted systems had the power plant in the fuselage, so that, if substituted directly in the examples quoted, the disposable load of the helicopter would be reduced by an amount equal to the weight of the power plant, i.e. by about six per cent of the gross weight, or ten per cent of the disposable load, and both would entail a further reduction in useful load for a given range to cater for increased fuel consumption. In all, a reduction in useful load varying from about 20 per cent for a flight of one hour to as much as 60 per cent for a flight of three hours, assuming an overall specific consumption of 1.4 lb hr lb thrust for the ducted systems. In a direct substitution, both systems would also considerably complicate the rotor head and blades by the introduction of large ducts for air or gas at elevated pressure and temperatures.

The problems involved in adapting the turbojet for operation at the tip of a rotor blade boiled down primarily to the fatigue life of the blading, and the provision of adequate bearings. The lecturer thought that the first of these problems was much less serious than it appeared at first sight. According to his estimates, the vibratory stresses in the blading due to gyroscopic action were unlikely to exceed some five per cent of the already existing centrifugal stresses—at least for the range of true giants—and he saw no reason why an acceptable service life should not be achieved.

The turbine bearings presented a more serious problem, and Mr. Fitzwilliams said he was now persuaded that there might be no solution for turbines mounted exactly as shown in his examples. He was therefore indebted to Dr. Morley, of the Napier Company, who suggested that the solution to the bearing problem might be found for turbines mounted parallel with, instead of across, the blade, partly because the centrifugal loads would then be spread evenly over the thrust bearings, and partly because the net thrust on the turbine shaft might considerably relieve the centrifugal loads.

The lecturer observed that he was not able to judge the significance of the second point, but the prospect of taking the centrifugal loads on thrust rather than on journal bearings was sufficiently attractive to overcome a certain resistance on his part to the idea of pushing a jet engine sideways through the air at the tip of a rotor blade. His objections on this score were soon overcome because if there was one simple lesson to be learned from the previous examples, it was that big helicopters had big, broad blades, allowing liberties which would not be permissible with the slender blades to which we were accustomed on small helicopters.

On sketching out a spanwise installation for the Sapphire, the virtues of the arrangement soon became apparent. In particular, the heavily-loaded thrust bearings need no longer be confined to the cramped and hot interior of the engine. They could, instead, be concentrated at the nose of the engine, where they could conveniently be up to a foot in diameter, and where they were favourably located in the cooling stream of intake air, as shown in Fig. 15.

Tentatively, he visualized a thrust-bearing assembly with relatively small-diameter ball or roller bearings, capable of taking the centrifugal loads when the engine was shut down in flight, but acting in conjunction with, and unloaded by, a pair of Michel bearings of comparatively large diameter, which would come into operation as the turbine was started up. As indicated in Fig. 15, the spanwise loads acting on the bearing assembly could conveniently be transferred, by means of a tie-rod, to the blade structure inboard of the engine installation. The loads arising in the turbine casing could be taken by the surrounding load structure which, with the blade members joining the turbine casing to the bearing housing, completed the triangulation in this area.

The spanwise installation was also attractive in that the turbine was not affected by the cyclic pitching oscillation of the rotor blades, and the steady gyroscopic couple arising from the yawing of the engine could be made to act as a relief of rotor-blade bending stresses in the flapping plane. The arrangement permitted easy cooling of the engine, and of the jet-pipe bend, from which some heat energy might be recoverable as a small thrust to reduce cooling losses. Even the long jet-pipe might ultimately be turned to advantage in a re-heat version of the giant helicopter.

The thickness of the aerofoil section enclosing the engine seemed at first sight to be a serious obstacle to good efficiency, but on further examination Mr. Fitzwilliams said he was surprised to find that the 0.012 mean blade profile drag coefficient already assumed in his examples would make sufficient allowance for the

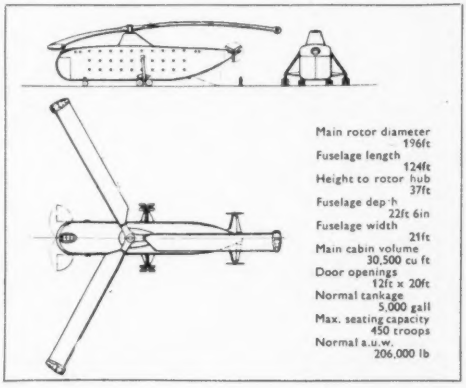

Main rotor diameter 196ft
Fuselage length 124ft
Height to rotor hub 37ft
Fuselage depth 22ft 6in
Fuselage width 21ft
Main cabin volume 30,500 cu ft
Door openings 12ft x 20ft
Normal tankage 5,000 gall
Max. seating capacity 450 troops
Normal a.u.w. 206,000 lb

Fig. 14. General arrangement of jet transport helicopter powered with three tip-mounted Sapphire turbojets.

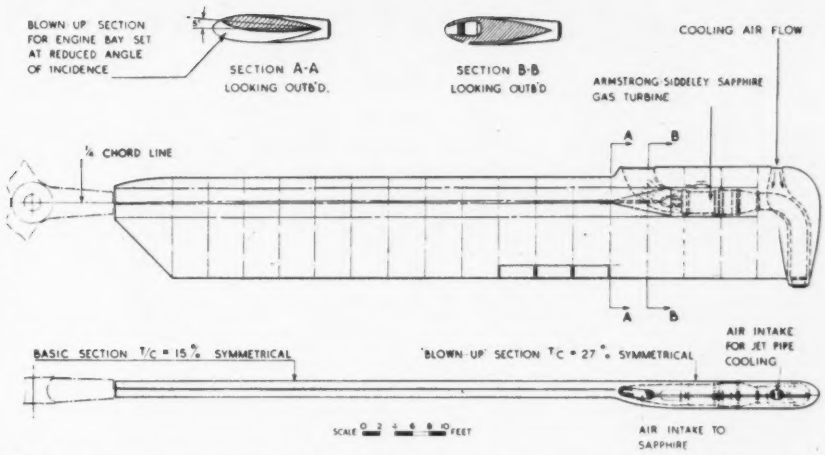

BLOWN UP SECTION FOR ENGINE BAY SET AT REDUCED ANGLE OF INCIDENCE
SECTION A-A LOOKING OUTB'D.
SECTION B-B LOOKING OUTB'D
COOLING AIR FLOW
ARMSTRONG SIDDELEY SAPPHIRE GAS TURBINE
¼ CHORD LINE
A
B
BASIC SECTION T/C = 15 % SYMMETRICAL
'BLOWN-UP' SECTION T/C = 27 % SYMMETRICAL
AIR INTAKE FOR JET PIPE COOLING
SCALE 0 2 4 6 8 10 FEET
AIR INTAKE TO SAPPHIRE

Fig. 15. Arrangement detail of spanwise installation of Sapphire in rotor blade tip.

tip aerofoil, which had a t/c ratio of 27 per cent. In a twin-Sapphire installation, the corresponding blade chord would be 40 per cent greater for the same depth, and the aerofoil enclosing the engines would have a t/c ratio of only 19 per cent.

The weight of the extra blade structure, plus the long jet-pipe, plus the additional bearing assembly and other modifications, might be assumed to increase the power-plant weight by perhaps 20-30 per cent, but the lecturer thought that it was not improbable that the static thrust of the Sapphire could, in due course, be increased by a similar percentage, in which case the relation which he had assumed between static thrust and engine weight would remain true for the modified power installation. In consequence, if his examples were revised, a helicopter powered by three Sapphires might turn out to be somewhat larger, and might be expected, for example, to carry 70 tons instead of 54 tons for a distance of 100 miles.

The curvatures of the air intake and jet-pipe would cause some loss of efficiency, but this could probably be reduced to a quite small percentage if sufficient attention were paid to the design of the jet-pipe bend. On the whole, he thought the effect on the range figures would not be significant, since the figures did not refer to the speed for best range. At a guess, he imagined the net result might be to drop the cruising speed to about 90 m.p.h. at the start of a long flight.

In conclusion, Mr. Fitzwilliams gave it as his impression that the manufacturing cost of a medium giant helicopter, including engines, was likely to run out at about one-fifth the cost of the large number of the best type of existing helicopters which would be required to carry the same total loads for the same distances. For many duties, the giant would not replace the smaller types, but in its proper sphere, he believed it was a good investment, economically as well as from a military point of view.

NEW BOOKS

"Air Bridge," by Hammond Innes. William Collins Ltd., 14, St. James's Place, London, S.W.1. Price 9s 6d.

HAMMOND INNES always takes great pains to ensure accuracy of background detail in his novels, and this story of the Berlin Air Lift owes much to a flight he made to the German capital aboard an R.A.F. transport at the peak of the operation. Its plot is concerned, however, not with the military, but with the civil side of the Air Lift, the main characters being three men and a Tudor.

It is no ordinary Tudor, for in place of its inboard motors it has two revolutionary new engines, designed by a German scientist and looted from him at the end of the war. Outstanding fuel economy is claimed for these units, and the story hinges round the efforts of three ex-R.A.F. airmen to complete the installation in time to prove the engines' capabilities on the Air Lift. When they write off the Tudor on its first test flight, the ruthless Saeton, driving force behind the enterprise, conceives the fantastic idea of pirating a replacement from the Tudor fleet already flying between Wunstorf and Gatow.

Whether or not this could actually have been done during such a closely-controlled and scheduled operation, the plan and its fulfilment certainly seem convincing enough when described by Mr. Innes. Unfortunately, they are complicated by murder and the re-appearance of the daughter of the German engine designer, with a man-hunt in the Russian Zone thrown in for good measure. The result is inevitable, but quite satisfactory.

"Wheels Round the World," by Alan Hess. Newman Neame, Ltd., 50 Fitzroy Street, London W.1. Illustrated. Price 15s.

READERS will recall that last June Mr. Alan Hess went considerably better than Jules Verne's hero by circling the world not in 80 days but in 21; for transport he employed an Austin A.40 sports car, and on the over-sea hops he transported it in a DC-4 chartered from K.L.M. and flown by Capt. Jimmy Bak. Hess had two co-drivers, and the usual routine was for two men to be in the car whilst the driver who was resting travelled in the aircraft. Over most of the journey contact between the Austin and the DC-4 was maintained by Pye V.H.F. radio.

Wheels Round the World tells, in its final section, the story of this remarkable trip. The earlier chapters have nothing to do with flying, but they nevertheless make excellent reading, for in them the author describes every notable round-the-world car drive made since, in 1902, a German-born doctor by the name of Lehwess started from London on a trip that ended, after some fantastic adventures, in a snowdrift near Nijni Novgorod.

"Foundations of Wireless," by M. G. Scroggie, B.Sc., M.I.E.E., Fifth edition. Published for "Wireless World" by Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Price 12s 6d. (postage 8d); 328 pages, 236 illustrations.

FIRST published in 1936, *Foundations of Wireless* has long since become established as a classic in its field, and scores of thousands have gained their first acquaintance with the principles of radio communication from its pages. This fifth edition has been entirely rewritten and is illustrated with over 200 new diagrams.

The whole basic theory of radio is covered, starting from elementary principles. Apart from the fundamental laws of electricity and radio, the theory of valves, transmitters and all types of modern receivers is reviewed, and there is an introduction to the techniques of television and radar.

A feature of special interest to the beginner is the introductory section, which explains fully the use of algebraic symbols, graphs and circuit diagrams. Equally valuable is the comprehensive system of indexing and cross-referencing, enabling the reader to find any information (and particularly the meaning of both British and American technical terms) without difficulty.

* * *

Recently published, at 63s, by the Trader Publishing Co., Ltd. Dorset House, Stamford Street, London, S.E.1, *Servicing Guide to British Motor Vehicles* will appeal not only to those engaged in the maintenance and repair of motor vehicles, but also to students of automobile design, to whom it offers a ready means of comparison, on equal terms, of a wide variety of vehicles.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Works Flying Clubs

THE Government has just announced a plan to encourage the formation of firms' flying clubs. These proposals should put new life into the amateur flying movement, but I feel that the optimism with which the announcement will be hailed in some quarters will not be justified.

For nearly five years I was associated with a works club of the type now to be set up. The firm in question, the Fairey Aviation Co., with great confidence and enterprise, has been subsidising initial hourly flying rates down to 25s. dual and 15s. solo.

The disillusioning thing is that, far from being overwhelmed with eager learners, the club has been poorly supported. In fact, I believe that in five years Private Pilot's Licence standard was attained by only two people under twenty-one years of age—a group in which the R.A.F. is most interested.

In short, if the experience of this club is a guide, the youth of this country (even that section in the aircraft industry) is not as madly keen to get into the air as is often suggested.

Cranfield, Bletchley, Bucks. R. P.

Rearward-facing Seats

ON the anniversary of the death of my cousin, Henry Warkentin, chief navigator of Curtiss-Reid, Montreal, who perished in *The Pilgrim* crash on Mount Obiou last year, and as an interested passenger in airliners, I venture to make a suggestion re backward-facing seats.

Why not compromise and manufacture aircraft with the seats on one side facing forward and on the other facing backward? This would enable passengers to select the seats they prefer and thus indicate a preference; after all, this is part of the problem. Secondly, when accidents occur there will be a controlled experiment to give evidence as to which type proves safest, or less dangerous.

Ile Bigras, P.Q., Canada. ALVIN THIESSEN.

Admiralty and Coastal Command

I HESITATE to waste more of your valuable space in replying to Mr. W. N. Cumming's letter in your issue of October 26th, but perhaps I may be in time to save Mr. J. B. B. D. Paul (of Toronto) a long-range reply at greater cost.

Your Epsom correspondent's "facts" do not become accurate merely by the divine virtue of his saying they are. In his first letter, for example, he disagreed with my contention that Coastal Command is of secondary concern to the Air Ministry, yet in the very next sentence asserted that, to the Air Ministry, "air superiority *must* come first" (my italics). To dismiss training (as he airily does in the same letter) as a "purely administrative problem" is surely sounding the depths of ignorance. It is the heart of the matter.

No; I'm afraid he entirely misreads my arguments. Air superiority is certainly essential—but it needs petrol and paraffin. The three Services form the legs of a stool; knock one away and the stool falls. By the same token, if one leg is too long, the stool wobbles. Sea air power, to be understood and used efficiently, requires knowledge born of long years of training and experience. You cannot just throw in a couple of Bomber Command squadrons at a moment of naval crisis, as your correspondent implies, and get a satisfactory answer. Nor can you have either an entirely efficient Coastal Command or Bomber Command if every now and then you swap the crews around between the two.

Gosport, Hants. ICARUS.

"Keeping Them Airborne"

CERTAIN aspects of your article on Field Aircraft Services, Ltd. ("Keeping Them Airborne," pages 627-628, November 16th) are, I consider, misleading, for the following reasons :—

(1) In 1933 Messrs. F. A. Kent and W. A. Rollason started a company known as Rollason Aircraft Services.

(2) On February 28th, 1935, Rollason Aircraft Services, Ltd., was formed, acquiring the business jointly run by Messrs. Kent and Rollason, who were made the first directors of this newly formed company.

(3) Messrs. Rollason and Kent sold the majority of their shareholding to British Continental Airways, Ltd., which gave B.C.A. controlling interest in this concern.

(4) Rollason Aircraft Services, Ltd., was continued as a company, and the name was not changed to Field Consolidated Aircraft Services, Ltd., until 1942, and then subsequently to Field Aircraft Services, Ltd.

Many of the famous record-breaking aircraft referred to in the article were treated, under the writer's supervision, by Rollason Aircraft Services, Ltd.

After the writer was demobilized from the R.A.F., a company known as W. A. Rollason, which subsequently became a limited company, was formed at Eastleigh Airport and expanded in 1946 to Croydon, where the main works are now situated.

Croydon Airport, Surrey. W. A. ROLLASON,
Director, W. A. Rollason, Ltd.

Master Pilot's Certificates

ON page 615 of *Flight* for November 16th it was stated that the first Master Pilot's Certificate valid for both land and marine types was issued to A.Cdre. Powell. This is, so far as I know, a perfectly correct statement. It is an equally correct statement to say that I am the holder of Master Pilot's Certificate No. 1, valid for both land and marine types. To explain the apparent contradiction I must give details of the two series of Master Pilot's Certificates that have been issued.

Series 1. This Certificate required the holder to have

(*a*) held a "B" Licence for not less than five years.
(*b*) a Second Class Navigator's Licence.
(*c*) flown at least 1,000 hours as pilot during those five years.
(*d*) as experience 200 hours on other single-engined (land or marine) flying machines of at least 300 h.p. or multi-engined (land or marine) flying machines, so that at least 100 hours was on multi-engined flying machines.
(*e*) done 200 cross-country or overseas flights, each of a minimum duration of one hour and both commenced and completed at night.

I have no doubt that A.Cdre. Powell holds No. 17 in this series. As a matter of fact I hold No. 19 in this series, but valid for landplanes only.

Series 2. This Certificate requires the holder to have

(*a*) held a "B" Licence for not less than five years.
(*b*) a First Class Navigator's Licence.
(*c*) flown not less than 7,000 hours as pilot or navigator.
(*d*) as experience 5,000 hours as pilot in command of public transport or aerial-work flying machines of which not less than 1,000 hours must have been on land types and/or marine types.
(*e*) 2,500 hours as pilot in command of multi-engined public transport or aerial-work flying machines.
(*f*) 500 hours as pilot in command of public transport or aerial-work flying machines at night, including not less than 200 departures or landings at night.

I hold No. 1 in this series, valid for both land and marine types.

I hope this clears up any argument in the matter; but I wonder if anyone else holds two Master Pilot's Certificates?

Westbury-on-Trym, Bristol. A. C. LORAINE.

FORTHCOMING EVENTS

Dec.	7.	Herts and Essex Aero Club: Annual Dinner and Dance.
Dec.	7.	G.A.P.A.N.: Reception, Mansion House, London.
Dec.	11.	R.Ae.S. Graduates and Students Lecture: "Naval Aircraft," by D. L. Hollis Williams, F.R.Ae.S.
Dec.	19.	R.Ae.C.: Film Show, London Terry House.
Dec.	20.	R.Ae.S.: "Control-surface Flutter," by E. G. Broadbent, A.F.R.Ae.S., and W. T. Kirkby, A.F.R.Ae.S.
Dec.	21.	Institute of Navigation: "Meteorology and Navigation," by Lt. Cdr. P. G. Satow, D.S.C., R.N.
Jan.	11.	A. and A.E.E., Boscombe Down: Contractors' Dinner.
Jan.	18.	Helicopter Association: "A Review of Helicopter Patents," by L. H. Hayward.
Jan.	18.	Institute of Navigation: "Navigational Errors," by W/C. E. W. Anderson, O.B.E., D.F.C., A.F.C.
Jan.	19.	Aircraft Recognition Society: Hurricane Trophy Competition.
Jan. 28-Feb. 1.		Institute of the Aeronautical Sciences: 20th Annual Meeting, New York.
Jan.	29.	Society of Instrument Technology: "Mechanical Consideration in the Design of Servo Systems," by Prof. A. Tustin.
Feb.	11.	Institute of Transport: Brancker Memorial Lecture, by Capt. E. D. Clarke, M.C.
Feb.	15.	Institute of Navigation: "Navigation Aids for Military Aircraft," by S/L. D. Bower.
Feb.	22.	Helicopter Association: "Helicopter Power Plants," by A. Graham Forsyth, B.Sc., F.R.Ae.S.
Feb.	23.	Society of Licensed Aircraft Engineers: Main Lecture: "Some of the Responsibilities and Problems of an Airworthiness Authority," by R. E. Hardingham, O.B.E., F.R.Ae.S., M.S.L.A.E.
Mar.	21.	Helicopter Association: "Recent Helicopter Research Investigations," by W. Stewart, B.Sc.

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HELLINIKON AIRPORT: Largely as a result of E.C.A. financial assistance with improvement programmes, the international airport at Hassani, Athens, has now become one of Europe's most important terminals. In this photograph new taxi-ways are seen under construction. Because of its consistently good weather record, Hellinikon is at the moment equipped only with a high-power radio beacon and a radio range.

CIVIL AVIATION

A SCOTTISH OCCASION

TO commemorate the 11th anniversary of transatlantic services to Prestwick, an exceptionally well-attended reception and dinner, given by Scottish Aviation, Ltd., was held at the airport on November 29th. This event has now become an important function in the civil-aviation calender and those who (like ourselves) are privileged to attend can always expect to find there many of the industry's leading personalities; all—thanks to the exemplary ministrations of their Scottish hosts—in most convivial mood.

The guest of honour at this year's function was the Hon. J. S. Maclay, C.M.G., M.P., Minister of Transport and Civil Aviation, and the "passenger list" included Air Chief Marshal Sir Frederick Bowhill, G.B.E., K.C.B., C.M.G., D.S.O. (Chief Aeronautical Adviser to the M.C.A.), the noted air-transport pioneer, Dr. Albert Plesman, president-director of K.L.M., and most of the senior executives of the airline companies using Prestwick, together with foreign Air Attachés. On arrival at Prestwick some 150 guests were welcomed by their hosts, the Duke of Hamilton and Brandon, P.C., G.C.V.O., A.F.C., and G/C. D. F. McIntyre, A.F.C., of Scottish Aviation, Ltd.

As one well qualified to speak of the history of Prestwick Airport, Sir Frederick Bowhill (who, as C.-in.-C of Transport Command, originally conceived the idea of using Prestwick as a transatlantic ferry base during the war) paid tribute to those responsible for its subsequent development and gave a spirited account of how Prestwick became prominent as a transatlantic terminal. He also expressed the hope that it would continue to grow in importance.

Later in the evening Mr. J. S. Maclay, speaking of the prospective future of the airport, said that although there had been differences of opinion on its physical development, there was undoubtedly a debt of gratitude due to Lord Clydesmuir for the contribution he and his colleagues had made in producing a fair, candid and comprehensive report on the subject. He regretted, however, that he was not in a position to reveal the policy which would be pursued in future. Prestwick, he said, was perhaps the most truly international airport in the country and one which, in effect, served Europe more than Great Britain. During the last 12 months the airport had handled some 92,000 transatlantic passengers, of which only 19,000 were travelling to or from the United Kingdom.

Locally—i.e., in Scotland—civil aviation was growing in an encouraging way, said the Minister. One-third of all the airports at present held and operated by the M.C.A. were in Scotland. During October, Prestwick alone had shown increases of 23 per cent in air-transport movements, 28 per cent in passengers handled and 49 per cent in terminal passengers, as compared with the corresponding month of the previous year. Ten times as many passengers travelled on Scottish domestic services today as in 1939 and 40 per cent of the internal traffic of all U.K. airports was handled by Scottish airports. This latter fact alone, he said, would bear out the importance of civil aviation in Scotland and, accordingly, of Scotland to civil aviation.

A particularly interesting discourse, which indirectly concerned the future of Prestwick, came from Dr. Plesman, who was responsible for many a raised eyebrow by reason of his pointed remarks on the immediate future of the air-transport industry—with particular regard to the introduction of jet transports. His own company, he said, was "not really interested" in the Comet at its present stage of development. In the first place, he thought, it was expensive and would match neither the capacity nor range of the Super-Constellation. He did not think it likely that the Series II Comet could be in service on transatlantic routes before 1958; in any case, its operating cost of 2½ cents per passenger-mile was "not really a commercial proposition" when it was considered that the Super-Constellation could offer a rate of 1½ to 1¾ cents per passenger-mile on the same route.

As far as his company was concerned, Dr. Plesman said that conversion of the Super-Constellation to turbo-prop power, a stage which should be reached by about 1956, would fill the gap which would occur until economical jet transports became available. The advent, also, of three classes of travel on North Atlantic routes was, he said, a prospect of the not-too-distant future.

Dr. Plesman referred also to the increasing use of titanium as a material for aircraft construction. Within a very short while, he claimed, it would revolutionize our present concepts of air-transport economics. If, for example, main spars were made of titanium, payload increases of 1,000-1,500 kg might be expected. It might, however, be six or seven years before the material was extensively used in aircraft.

Following the dinner, discussion among individual guests lasted well into the early hours of the morning and we have no doubt that many far-reaching decisions were arrived at. A few of them, at least, we hope will have a bearing on the future of air transport.

B.I.A.T.A.'s ANNUAL REPORT

ON November 27th, the British Independent Air Transport Association held its quarterly gathering; though a social occasion attended by many representatives of the air transport industry at large, it was one which was actually organized to follow the more serious business of hearing a report of the Association's activities for the year 1950/51. This report reveals a considerable change within the nature of the industry as compared with the preceding years. During the four preceding years independent companies operated under considerable difficulties, as a result of which a heavy percentage of the operators were eliminated completely while the rest of them underwent a process of consolidation. Largely because of this change the Association thought fit to alter its name from B.A.C.A. to B.I.A.T.A.

Of B.I.A.T.A.'s work during the past year the report mentions particularly the efforts which were made by the Association to maintain a supply of aircrew in order to alleviate the present serious shortage. In this connection, incidentally, the Association deplores the fact that the British Government "has hitherto failed to appreciate sufficiently early the seriousness of the situation." Some measure of success has been reached, the report states, in obtaining alleviation of certain legislation which would otherwise tend to accentuate the shortage of personnel. The Association hopes, moreover, that the Government will in future set up some scheme for the direct assistance for ex-Service personnel who wish to qualify for posts in civil air transport.

Other aspects of the Association's work are mentioned, notably those connected with the representation of member's interests in discussions on Associate Agreements and with representations to I.C.A.O., the Air Transport Advisory Council and the M.C.A.

Mr. Eric Rylands of the Lancashire Aircraft Corporation was re-appointed chairman of the Association. Pictures of personalities at the party appear on page 736.

CIVIL AVIATION . . .

SABENA'S HELICOPTER MAILS

THE Belgian airline, Sabena, reports that the results of its first-year helicopter mail service operations have been highly encouraging. The service is flown daily on a roughly circular route from Brussels to eight provincial points, a total distance of 268 miles. At two of these points refuelling is carried out. During this first year, a total of more than 50 tons of mail has been lifted (representing some 4,630,000 letters), an average of 400 lb per operational day. In the peak month of June, 14,780 lb were carried.

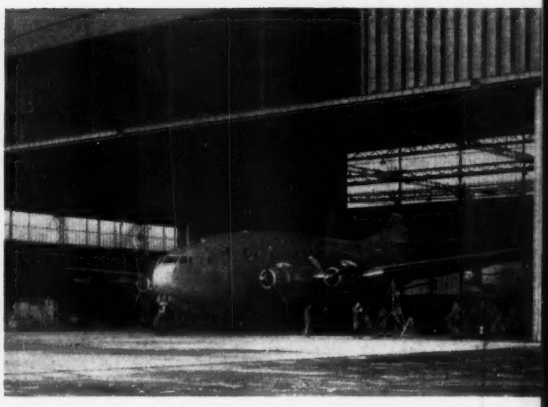
The helicopters used (two Bell 47D1s) achieved an average regularity of 91.2 per cent over the whole circuit, while the regularity at stopping points averaged 86 per cent. Only 9 per cent of the total flights had to be interrupted because of weather and 5 per cent for technical reasons.

Excellent though these figures are as they stand, it should be stressed that in helicopter operations of this nature a technical delay of more than half-an-hour on a certain route compels the carrier to interrupt his service at other points, thus causing a considerable deterioration of the statistical regularity results. Next year Sabena hopes that the overall regularity figure will increase to 95 per cent, and with this in mind the company has equipped two machines for instrument flying.

"DEUX PONTS" PRODUCTION LINE

DURING a recent visit to France we were able to see something of the progress now being achieved with the Bréguet 761 and 763 series of double-deck freighters, some 16 of which are now in process of construction. Four aircraft had already flown and three more were seen to have reached the engine-fitting stage.

New tail modifications have been embodied in both versions, which now have completely rounded trailing edges to their rudders. One 761 all-cargo version, destined for Air Algérie, has already been fitted for delivery and Air France will soon receive the first of its 763 mixed cargo and passenger machines. The 763, incidentally, has a wing-span 4ft. greater than that of the 761, and is also characterized by two rows of windows and more powerful engines. When it goes into service, the 763 will probably operate at a gross weight of 48 tons which, later, may be increased to 50 tons.



The first Deux Ponts 761 ordered by Air Algérie and, as mentioned on this page, will be delivered shortly. It is an all-cargo version.

Although the machines which to date have reached the engine installation stage are being fitted with Pratt and Whitney CA-18s (with water-injection), it is understood that the later numbers off the production line will have CB-16s. Air France has officially ordered eight of these aircraft, but it now seems likely that this number may be increased to 12 in the near future. One 761—actually the prototype—is being fitted experimentally by the French Navy at Toulouse with S.N.E.C.M.A. engines, and a sister-craft is now at the *Centre d'Essais en Vol* at Marignane for test flying and certification.

BREVITIES

INTERNATIONAL airline traffic transactions settled through I.A.T.A. Clearing House at London totalled $120,432,000 for the first nine months of this year, an appreciable increase over the total for the corresponding period of 1950. The offsetting of credit and debit balances for the 33 members of the Clearing House eliminated the need for cash settlements on 90.2 per cent of all claims.

* * *

The municipal authorities of Southend have asked Silver City Airways to start a new car-ferry service from Southend to Ostend and possibly to Le Touquet. The company's executives recently visited Southend Airport and were impressed by the facilities which they found there. Concrete proposals for the operation of this new route will probably be forthcoming before the end of the year.

* * *

Appreciable increases have been reported recently in American traffic to Israel by El Al, the Israeli national airline. The fact that the country is fast achieving popularity as a tourist resort is also accounting for a considerable increase in the number of passengers from Europe. El Al—which in 1949 was operating only two DC-4s—has now so increased its business that three Constellations, three DC-4s and four C-46s are necessary to handle the traffic.

* * *

In *Notice to Licensed Aircraft Engineers and Owners of Civil Aircraft, No.* 37, *Issue* 1, the A.R.B. draws attention to the fact that, after heavy loading of the Siebe Gorman type of safety belt, it has been found that the buckle lever will pull down flat on to the webbing; in this position it is difficult to obtain sufficient purchase with the finger-tips to apply the necessary release pressure. As a safety-measure, therefore, existing buckles not stamped with the figures "37" must be modified in accordance with the instructions given in the *Notice*.

* * *

On December 4th Indian Airlines started a regular weekly service from Calcutta to Kabul (Afghanistan) by way of Karachi and Zahidan (Persia). This 2,000-mile circuitous route has been necessitated by Pakistan's refusal to allow flights over her North-West Frontier.

* * *

Mr. Ian A. Gray has been appointed assistant to the president of Canadian Pacific Airlines, at the latter's headquarters in Vancouver. Mr. Gray vacates the post of general superintendent of engineering in Canadian Pacific Airlines upon taking up his new appointment, and will be succeeded by his former assistant, Mr. F. M. Francis, of Vancouver.

* * *

The M.C.A. has issued a further *Information Circular* (No. 148/51) dealing with the subject of hazardous flying by civil light aircraft. It draws attention to the fact that since the first notice was issued a further seven people have lost their lives in four accidents which occurred because pilots indulged in hazardous flying at such a low altitude that there was insufficient height to allow for errors of judgement. The manœuvres included steep climbing turns, steep turns and diving. The M.C.A. also calls attention to the fact that all pilots should be aware of the provisions of Schedule II of Air Navigation Order (1949) which required them to observe, *inter alia*, certain minimum safe altitudes and not to fly in a reckless or negligent manner so as to endanger lives or property.

* * *

B.O.A.C. is now negotiating with certain shipping companies in the Mediterranean and Middle East areas with the object of completing a number of combined air-sea travel agreements. The advantages of making an air journey in one direction and a sea voyage on the return (or *vice versa*), each at a half of the respective return fares, are already available to passengers on certain of the Corporation's routes. The three shipping lines with which B.O.A.C. has already concluded agreements are Farrell (services to South Africa), Furness Bermuda (services between U.S.A. and Bermuda) and Moore-McCormack (circular or round trips within the Western hemisphere and between the Americas and Europe).

* * *

Last week the Guatemalan Government inaugurated regular services between Guatemala City and Belize (British Honduras). Twice-weekly services will be flown by Aviateca, a State-owned airline. After lengthy discussion, agreement on landing rights was finally reached at a time when tension between Guatemala and British Honduras had increased considerably (the former country has disputed British sovereignty over Honduras and recognizes the Colonial Government only *de facto*). The Guatemalan Government has specified that in no circumstances can the agreement be considered a retraction of its claims to sovereignty.

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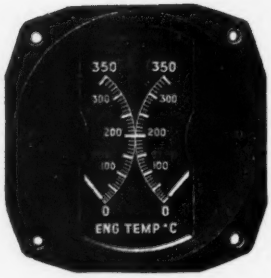

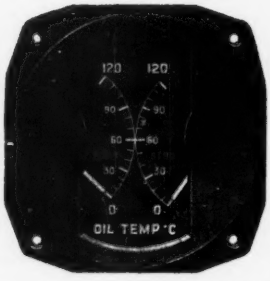

Illustrations show:

Above, Model 5128. Dual Engine Temperature Indicator, comprising two Millivoltmeters of 100° scale housed in large-size S.A.E. case. For use in conjunction with copper/constantan, iron/constantan or chrome/alumel thermocouples.

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CIVIL AVIATION . . .

A bilateral agreement negotiated in January between the United Kingdom and the Government of India was formally signed in New Delhi on December 1st. The agreement takes effect retrospectively from August 1st, the date from which the re-organized services of B.O.A.C., on the one hand, and those of Air India International and Bharat Airways on the other, have operated. B.O.A.C. are now scheduling eight services a week from the U.K. to and *via* India; A.I.I. flies four services between India and the U.K. and one between India and Nairobi, while Bharat Airways run a weekly service to Singapore.

* * *

The Lockheed Aircraft Corporation announced last week that the new 88-passenger Super-Constellation (actually the largest aircraft certified to date for commercial service) has received its C. of A. from the Civil Aeronautics Administration endorsed "for immediate passenger operations." The first machines will go into service this month with Eastern Air Lines between New York, Chicago and Florida; 68 Super-Constellations have been ordered to date.

According to a ruling which became effective on December 1st, pilots and crews of civil transport aircraft plying between points in Europe will no longer be required to carry passports. This facility was agreed upon by the I.C.A.O. Conference at Chicago last year.

* * *

Meeting in Buenos Aires last week, the plenary session of the I.C.A.O. Facilitation Division heard the report of a special committee on "direct transit traffic" and customs-free airports. The report stated : "It would be premature to recommend any modifications to the present procedures and, in any case, only two countries —America and France—plan to take action in this direction." It mentioned, also, that there were only two customs-free airports in the world, Shannon, in Ireland, and Tocumen (Panama). In another part of the report it was revealed that the Argentine Government is expected to issue a decree this week simplifying airport procedures—a course which has been described by observers as one of the most constructive developments to date. Among subjects to be discussed at the meeting were improvements and standardization of passenger- and cargo-handling facilities and the establishment of direct transit areas at international airports.

FROM THE CLUBS

"Flight" photograph

PIPER PACER: A development of the Super Cruiser, one of these trim little aircraft, looking spick and span, was photographed at Entebbe by the Editor during his recent trip to Africa.

FOLLOWING the inaugural meeting of the Vintage Aeroplane Club at White Waltham on November 3rd, a second gathering —which attracted some 42 enthusiasts—was held on December 1st at Denham, where further plans were discussed.

It was agreed to hold a week-end rally and flying display on January 19th-20th, the programme of which will include competitions for spot-landing, bombing and slow flying, together with a display by a vintage Autogiro. A film show will be held in the evening. Should the weather prove unsuitable for flying on the Saturday, however, the airborne side of the programme will take place on Sunday, which will otherwise, it is hoped, be spent in allowing members to fly one another's machines. Incidentally, one of the club's first members, Mr. Douglas Bianchi, is making available his Puss Moth, G-AAZP (believed to be the oldest machine flying regularly in this country) for use by suitably qualified members.

It is thought likely, also, that one or more of the veteran aircraft owned by Hawker Aircraft, Ltd., may "join" the club.

The club has now evolved a third form of membership, to be known as student membership, and to be open to those under the age of 17. The object is to encourage general interest in vintage aircraft, with the added attraction of occasional free joy-rides. The fee for a student member is to be 10s 6d—the same as that for an Associate Member. To date the membership of the V.A.C. stands at over 30, some 15 of whom are full members.

The club has already been recognized by the M.C.A. as being eligible for fuel-tax relief, which will apply both to aircraft operated by the club or to syndicates within the club.

FROM South Africa we learn that the Chief of the General Staff has authorized the S.A.A.F. to contract with civil flying clubs currently engaged in the training of pupil pilots to receive a number of reserve officers previously engaged on flying duties for 20-hour refresher courses on Harvard aircraft. The courses will also include 20 hours of ground instruction and will last for 14 days. Each club will be required to provide facilities for this course for 20 or 30 students a year, depending on the resources of the individual club and the availability of students. Conferences with representatives of the clubs are being arranged.

THE Strathtay Aero Club's Annual General Meeting, held recently in the club-house, brought forth an unusually good attendance of members. In the absence of the president, Sir John Ure Primrose, the chairman, Mr. R. B. Henderson, outlined the club's activities during the past year. The total of hours flown, he said, was 1,917 and the number of Private Pilots' Licences obtained was 46.

After a detailed review of the club's progress the chairman concluded by congratulating the instructors for their contribution towards the success of the year's operations.

Flying times for November were reported to be below previous monthly figures. Flying weather had been poor and, up to the 21st of the month, only 46 hours had been recorded. Two A.T.C. Cadets qualified for their P.P.L.s during the month, bringing up to 45 the total of licences gained since the scholarship scheme started.

WITH a total to date of 1,350 hours flown, Denham is at the moment one of the country's busiest clubs. This year, some 24 pupils have reached the solo stage, six Private Pilots' Licences have been awarded and two would-be commercial pilots, Messrs. Bell and Howard, are now studying for their final tests.

At Denham, also, the fair sex is well represented, Miss Angela Norman and Miss Dyer having been accepted for the W.R.A.F.V.R., while a further six women pilots are now under instruction.

The club fleet consists of two Magisters, three Austers and one Proctor. With the advent of the new scheme for cheaper flying, Denham is expecting a useful increase in its already large membership—particularly in view of its very convenient location in relation to central London.

THE PATHFINDER BALL

A GREAT many Pathfinders and their guests last Saturday, December 1st, made a thoroughly enjoyable sortie to the Pathfinder Club's annual ball, at the Dorchester Hotel, London. Among the more famous of the guests present from the entertainment world were Miss Gladys Ripley, Richard Todd, John Sutro, Michael Dennison and his wife, Dulcie Gray, and the very popular radio couple, Barbara Kelly and Bernard Braden. One of the cabaret acts was an exhibition of square dancing by the Butlin Square Dancers, who thereafter acted as instructors for dummy runs by the guests, the results being positively hilarious. All in all, it was a thoroughly enjoyable function.

TALKING ABOUT AIR TRANSPORT

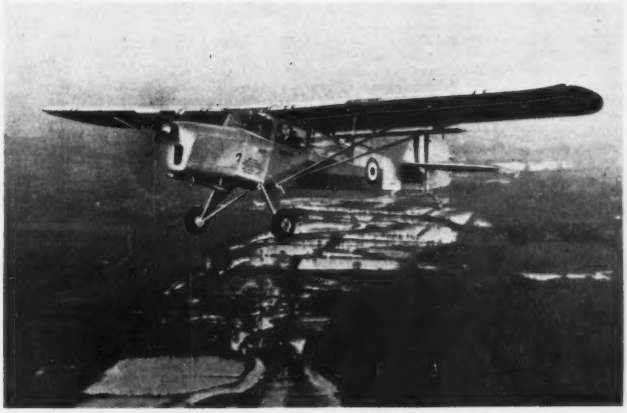
AS reported on page 733, members of the British Independent Air Transport Association held their quarterly gathering on November 27th, and, following a meeting, members had useful informal chats, over a stand-up lunch, with a number of senior officials of the two aviation ministries.

"Flight" photographs

(1) *Mr. J. S. Maclay, Minister of Transport and Civil Aviation, with Sir Donald Banks (Air Transport Advisory Council) and Air Chief Marshal Sir Guy Garrod (Air League).* (2) *Air Chief Marshal Sir Frederick Bowhill, Chief Aeronautical Adviser, M.C.A., with Sir Guy Garrod and Sir James H. Barnes, Permanent Under Secretary, Air Ministry.* (3) *Mr. Eric Rylands, B.I.A.T.A.'s chairman, with Sir Wavell Wakefield, M.P. (Lancashire Aircraft Corporation).* (4) *Sir Arnold Overton, Permanent Secretary, M.C.A.; Sir Wavell Wakefield, Lord Terrington (Air Transport Advisory Council), A.Cdre. Harvey, M.P. (Silver City Airways), and Mr. David Brown (L.A.C.).* (5) *Mr. P. A. R. Bremridge (Conservative H.Q.), Sir Donald Banks, Mrs. Whittaker (secretary, B.I.A.T.A.), Sir George Cribbett (Deputy Secretary, M.C.A.).* (6) *G/C. G. E. McIntyre (Scottish Aviation), and Sir Alfred Le Maitre (M.C.A.).* (7) *Mr. Maclay, Mr. Rylands, Lord Waleran (E. K. Cole, Ltd.), and G/C. C. S. Morice (Dunlop).* (8) *A. Cdre. G. J. Powell and Gen. Sir Edwin Morris (Silver City Airways), A.Cdre. Sydney Smith (Lancashire Aircraft Corporation).*

SERVICE AVIATION

Royal Air Force and Naval Aviation News



OVER THE FLOODS: One of the last of the present contract for Mk 7 Austers being test-flown over the flooded River Soar. The contract is replaced by another to produce the Mk 6 type.

R.A.F Aides-de-Camp

IN a R.A.F. supplement to the *London Gazette* it is announced that A. Cdre. J. H. Edwardes-Jones, C.B.E., D.F.C., A.F.C., and G/C. R. L. M. Hall, O.B.E., have been appointed as Aides-de-Camp to the King. They will succeed A. V-M. R. B. Jordan, C.B., D.F.C., and A. Cdre. O. W. de Putron, C.B., C.B.E., respectively.

Visitor to R.A.A.F.

THE C.A.S. of the Royal New Zealand Air Force, A. V-M. D. V. Carnegie, has recently returned from a visit to Australia. When announcing the visit Mr. McMahon, the Australian Minister for Air, said the purpose was to establish closer contacts between the R.N.Z.A.F. and the R.A.A.F.

A. V-M. Carnegie left for Britain on Monday last, accompanied by W/C. T. F. Gill.

Director of Auxiliaries

SPEAKING at a meeting of the City of London Territorial and Auxiliary Forces Association at the Mansion House recently, Mr. Nigel Birch, Under-Secretary of State for Air, announced that a new post designated Director of Auxiliaries, Reserves and Air Cadets, was being created. The holder is to have sole responsibility for the welfare of these branches. Under him, a group captain would serve as an inspector of the R.Aux.A.F. and both officers would have direct access to the Air Council.

At the same meeting, Mr. Birch said that the King had approved the award of squadron standards to the R.Aux.A.F. under the same conditions as those obtaining for the award to regular units—25 years' continuous service, or as an award for some special service. A number of squadrons, including No. 600 (City of London) Squadron, of which the Queen is the Honorary Air Commodore, have already complied with the long-service qualifications.

N.S. Men Complete Course

THE first group of National Servicemen to complete their training as pilots in this country were told on November 21st by Air Marshal Sir Hugh S. P. Walmsley that he believed air power could now take the place of sea power in ensuring peace. "Just as British sea power secured the peace of the world for one hundred years after the Battle of Trafalgar, so, I believe, can the combination of American and British air power ensure the peace of the world for the next hundred years."

Sir Hugh, who is A.O.C.-in-C. Flying Training Command, was addressing the 35 pilots on the course after he had presented them with their wings at a passing-out parade at R.A.F. Station, Dalcross, Inverness-shire. In addition to their wings the pilots have also received their commissions as pilot officers.

After congratulating the pilots on their smartness on parade, the Air Marshal paid a general tribute to the quality of the National Servicemen who were serving in all branches of the R.A.F. "Without the very effective support of the National Service element, it would be quite impossible for us to have expanded at the rapid rate at which we have already done," he said.

The distinction of being the outstanding student pilot on the course, for which he received the Bridgeman Trophy, went to Off Cdt. David V. Finch.

COMBINED EFFICIENCY: Lt. Gen. Sir Cameron Nicholson taking the salute at the march-past on the occasion of the presentation of the A.O.P. Efficiency Cup to No. 663 Air Observation Post Squadron at Hooton Park, Cheshire. (See paragraph in column 3.)

"Sydney" reaches 1,000

THE Australian carrier, H.M.A.S. *Sydney*, now on the Korean station, has already completed over 1,000 operational sorties. During a recent period of only eight days, 401 sorties were flown from her deck. The score board now shows 14 bridges wrecked, seven others damaged; seven junks destroyed and a further 54 damaged.

A.O.P. Efficiency Cup Presented

A JOINT ceremony in which No. 663 Air Observation Post Squadron, Royal Auxiliary Air Force, was presented with the A.O.P. Efficiency Cup and with its new official crest was held at Hooton Park R.A.F. Station, Cheshire, on November 25th.

The joint Territorial Army/R.Aux.A.F. nature of the unit was emphasized by the fact that the Cup was presented by Lt. Gen. Sir Cameron Nicholson, G.O.C. Western Command, and the crest by A. Cdre. W. H. Merton, A.O.C. 63 (Western and Welsh) Group.

The Squadron, which has outlying

SERVICE AVIATION . . .

flights at Ringway (Manchester), Wolverhampton, and Cardiff, has been awarded the Cup this year after competing against similar units in the British Isles. The award is made to the squadron with the best record in flying and training hours, in recruiting, and in efficiency in the field exercises carried out at annual camp. This year No. 663 Squadron was represented by the Manchester Flight, No. 1951, in the exercise at camp.

Maj. J. R. Bandy, R.A., Commanding Officer, received the Cup and crest on behalf of his squadron, and the parade was attended by the unit's Royal Artillery pilots and its mixed R.Aux.A.F. and R.A. ground crews and observers.

Nos. 610 and 611 Fighter Squadrons, R.Aux.A.F., which are based at Hooton Park, also took part in the parade.

The Squadron's new crest bears a Polish eagle, a snaffle bit, and the motto, "We Fly for the Guns." The eagle symbolizes the unit's early associations with the Polish Corps in Italy—it was formed as a mixed British and Polish unit in 1943 under the command of Capt. Erdley Wright, who is still serving in the unit as a Territorial. The bit symbolizes the control which the A.O.P. pilots exercise over field artillery.

Presentation to H.M.S. "Triumph"

WHEN the aircraft carrier H.M.S. *Triumph* arrived at Spithead on November 22nd, Brig. E. E. J. Moore, Colonel of the Inniskillings, went on board and presented to the ship an Inniskilling regimental flag to commemorate the hospitality shown to the 1st Inniskillings during their recent voyage to the Middle East. Capt. U. H. R. James, C.B.E., R.N., the commanding officer, accepted the flag on behalf of the ship's company.

Machrihanish Recommissioned

ON Saturday last the Royal Naval station at Machrihanish, Argyllshire, was re-commissioned as H.M.S. *Landrail* under the command of Capt. G. C. Dickins, R.N., formerly Director of Air Equipment at the Admiralty.

The new station will be used to train pilots returning to the service after a spell of civil life. A large proportion of the first course, which will begin early in the new year, will come from the New Zealand Volunteer Reserve.

NAVAL VISITOR: Rear Admiral A. K. Scott-Moncrieff, R.N., visits the American escort carrier U.S.S. "Rendova" to plan future operations with Capt. E. E. Fickling. The carrier is part of the blockading force in Korean waters.

BAND LEADERS: Local interest in the two navigating Mosquitoes which led the recent jet-aircraft staging-route survey flight between the Canal Zone and South Africa. They are shown at Belvedere Airport, Salisbury, Southern Rhodesia. Altogether eleven aircraft took part in the flight —two Mosquitoes, five Valettas and four Vampires.

The Dacre Trophy

A TROPHY to be awarded annually to the regular squadron of Fighter Command showing the greatest proficiency in weapons training has been presented by A. Cdre. G. B. Dacre, C.B.E., D.S.O., D.L., R.A.F. (ret.), and Mrs. Dacre, J.P., in memory of their son, F/O. K. F. Dacre,

The Dacre trophy presented to Fighter Command for competition.

D.F.C., who was killed in action over Germany in 1943.

The Dacre Trophy, which is of bronze mounted on a marble base, takes the form of three classical archers, executed by A. E. Sean Crampton, G.M., M.C. It will be awarded to the Fighter Command squadron achieving the best results during the annual attendance at armament practice camp, when squadrons will be assessed on their previous 12 months' weapon-training effort. Emphasis will be placed on live air-to-air firing, and all squadron pilots must compete.

F/O. Dacre entered the R.A.F. in 1940, and in 1943 joined No. 605 (County of Warwick) Squadron which was then engaged on night intruder operations. He was credited with destroying three enemy aircraft. His father, A. Cdre. Dacre, learned to fly in 1911 (his pilot's certificate is No. 162) and served in the R.N.A.S. in the first World War, winning the D.S.O. for flying operations in the Dardanelles. He is vice-chairman of the Sussex Territorial and Auxiliary Forces Association and a Deputy Lieutenant of Sussex. Mrs. Dacre served throughout the war in the W.A.A.F., attaining the rank of group officer.

R.C.A.F. Appointments

IT has been announced that A. Cdre. F. S. Carpenter, A.F.C., C.D., has been appointed Chief of Training at Air Force Headquarters. Until recently A. Cdre. Carpenter was Senior Staff Officer at Training Command H.Q.

G/C. F. C. Carling-Kelly, A.F.C., C.D., will be one of the Canadian representatives to attend the first course to be held at the new N.A.T.O. Defence College in Paris. G/C. Carling-Kelly has been serving as Canadian air attaché in Paris since 1949 and will remain there for the college course.

G/C. W. Newson, D.S.O., D.F.C., who has been commanding R.C.A.F Station, Centralia, for some time past, has been transferred to Training Command H.Q. The new C.O. at Centralia is G/C. W. Bean, O.B.E.

Moving from the R.C.A.F. Staff College at Toronto, G/C. H. C. Ledoux, D.F.C., C.D., is to become Senior Personnel Staff Officer at Air Defence Command H.Q.

First Flight from "Eagle"

THE first pilot to take off from the new 45,000-ton carrier, H.M.S. *Eagle*, was Lt. S. A. Mearns, D.S.C., R.N., who left the ship in a Sea Fury at 1130 hr on December 3rd.

Lt. Mearns is the senior pilot of the Service Trials Unit at the R.N. Air Station at Ford, Sussex. He had been in the ship for several days in connection with catapult-loading trials.

R.N.V.R. Squadron Wants Pilots

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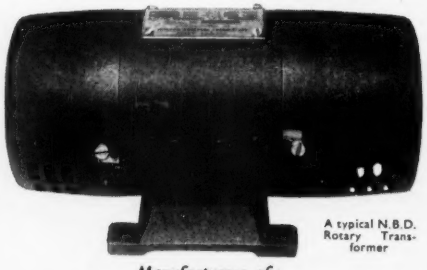

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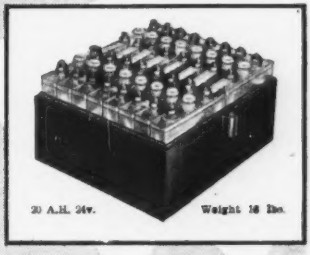

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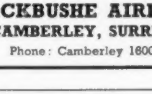

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APPLY, in writing, to the Employment Manager, Vickers-Armstrongs, Ltd., (Aircraft Section), Weybridge, Surrey. [7327

HANDLEY PAGE, Ltd., have vacancies for:—

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APPLICANTS should state age, experience, qualifications and salary required, to the Personnel Officer. [7353

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JIG and tool draughtsmen required. Previous aircraft experience not essential.—Apply, Employment Manager, Vickers-Armstrongs, Ltd. (Aircraft Section), Weybridge, Surrey. [7328

APPLICATIONS are invited from design draughtsmen and stressmen; also technical assistants with combined design and performance experience for work on both reciprocating and gas turbine aero engines.

APPLICATIONS should state full particulars of experience and qualifications, and should be addressed to The Personnel Manager, The de Havilland Engine Co., Ltd., Stonegrove, Edgware, Middx [0575

LICENSED radio engineer and radio mechanics at our base at Stansted Airport, Essex.—Apply, by letter or telephone, to the Senior Radio Engineer, Aviation Traders Ltd., Southend Airport, Essex. Tel.: Rochford 56491. [0650

ONE junior weight engineer required for work on aircraft structures and guided missiles.—Please write giving full particulars of age, experience, salary required, etc., to Box 5396, quoting ref. F.14. [7302

INTEGRAL Ltd., Cousins Street, Wolverhampton, have vacancies on the technical staff in the experimental and development department on work connected with aircraft hydraulic systems. [7298

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SIGNALS instructor required by Reserve Flying School. R.A.F. aircrew signaller experience essential.—Apply, in writing, stating experience and age, to Secretary, Universal Flying Services Ltd., Fair Oaks Aerodrome, Chobham, Surrey. [7365

AIRCRAFT fitter assemblers required by de Havilland Aircraft Company, Hatfield. Good working conditions, modern equipment, superannuation scheme, opportunities for advancement.—Apply in person or by letter to Personnel Manager, or telephone Hatfield 2345. [0630

LICENSED engineers, A. and C. or A. for light aircraft maintenance. C. of A., repairs and club duties. Also fitters, airframe and engine required. Good rate of pay and prospects.—Apply, Wolverhampton Aviation Ltd., The Airport, Wolverhampton. [7324

ADVANCED project of national importance requires propulsion technicians with knowledge of aero or thermodynamic theory. Approximately Higher National Certificate standard.—Apply, stating age, experience and salary required, to Box 5532, quoting Ref. M.3. [7346

TECHNICAL authors required for compilation of spare parts catalogues. Ex-R.A.F. or Fleet Air Arm personnel with maintenance experience an advantage.—Apply, giving full details of experience, to Personnel Manager, de Havilland Aircraft Co., Hatfield. [7344

THE COLLEGE OF AERONAUTICS has vacancies for experienced female air traffic control clerks and R.T operators. Hostel accommodation available.—Applications should be made in writing to The Registrar, The College of Aeronautics, Cranfield, Bletchley, Bucks. [7360

TECHNICAL authors and illustrators required. Knowledge of M.o.S. procedure desirable.—Applications, in writing stating age, experience and salary required, to Personnel Manager, Percival Aircraft, Ltd., Luton Airport, Beds. [0594

SENIOR, intermediate and junior mechanical draughtsmen wanted for aircraft work. Previous aircraft experience not essential. Pension and life assurance scheme.—Apply, Employment Manager, Vickers-Armstrongs, Ltd. (Aircraft Section), Weybridge. [6930

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SENIOR and junior weight engineers required. Interesting work on new projects. Permanent positions offered to suitable applicants.—Apply, stating age, experience, qualifications and salary required, to Chief Designer, Gloster Aircraft Co., Ltd., Witcombe, Glos. [0912

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SALARY approximately just over £2,000 per annum.

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DRAUGHTSMEN, senior and junior mechanical engineering draughtsmen urgently required, also a lady tracer. Ring or write Personnel Superintendent at Blackburn and General Aircraft Co., 121, Brough. Ext. 133. The Labour Office is opened on Saturdays. Fares refunded to applicants calling at Brough for interviews. [7248

PLANNING engineers (aircraft) required. Considerable production planning experience and sound knowledge of metal airframe components manufacture essential.—Applications in writing to Personnel Manager, Percival Aircraft Ltd., Luton Airport, Beds., stating age, experience and salary required. [7273

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DRAUGHTSMEN and stressmen required by aircraft firm in the Midlands for work on research, aerodynamics and stress analysis.—Applications are invited from men with an aeronautical or mechanical engineering degree or equivalent qualifications. The positions offer good prospects.—Apply, stating age, experience, etc., to Box 5559. [7355

DOWTY EQUIPMENT, Ltd., Aircraft Hydraulic Engineers, Arle Court, Cheltenham, require a senior technical writer used to engine work, also detail and senior design draughtsmen. Excellent environment and working conditions. Pension scheme.—Write Personnel Manager, giving details of training and experience, and mentioning age and salary expected. [7356

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SENIOR and junior technical assistants are required for experimental and development work on aircraft propulsion units. Candidates should be for an engineering degree or its equivalent. Previous experience of this type of work is desirable but not essential.—Reply, giving details of qualifications and experience, to Ref. S.A.2, Armstrong Siddeley Motors, Coventry. [7316

DRAUGHTSMEN. Vacancies exist for first-class men in the jig and tool also design and loft departments. Those with aircraft experience preferred but others with good mechanical and structural knowledge welcomed. Limited single board accommodation available.—Apply, in writing or in person, to the Labour Manager, Fairey Aviation Co., Ltd., Heaton Chapel, Stockport. [7333

EXPERIENCED aerodynamicist required for responsible position in aerodynamics department. Minimum requirements B.Sc. (or equivalent), several years' experience, ability to undertake all normal performance, stability and other aerodynamic work.—Applications, in writing, to Personnel Manager, Percival Aircraft, Ltd. The Airport, Luton, Beds., giving details of training experience, age and salary required. [0600

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SENIOR technical assistants required for engine technical office. Knowledge of engine stress calculations and mechanical testing, including vibration analysis desirable. B.Sc. and/or A.M.I.Mech.E. preferred.—Write, giving age, previous experience and qualifications in chronological order to The Personnel Officer, The de Havilland Engine Co., Ltd., Stag Lane, Edgware, Middlesex. [7284

APPLICATIONS are invited for the following positions in the London area: Draughtsmen required for detail drawing of experimental designs of aircraft electrical equipment. Works experience essential.—Write, giving full details in strictest confidence to the Employment Officer, Rotax, Ltd., Chandos Road, Willesden Junction, N.W.10. [7271

THE GLOSTER AIRCRAFT Co. requires senior and intermediate stressmen to work on designs and projects of advanced interest. Excellent prospects of advancement for sound and energetic men.—Apply, in the first instance, giving full particulars of technical qualifications, age, experience and salary required, to The Chief Designer, Gloster Aircraft Co., Ltd., Hucclecote, Glos. [0914

AIR FORCE, Naval, civil and helicopter aircraft all under design and development at Percival Aircraft, Ltd. Applications are invited from senior and junior draughtsmen, and stressmen, for work on this interesting programme.—Write, giving details of experience and salary required, to Personnel Manager, Percival Aircraft, Ltd., Luton Airport, Luton, Beds. [0595

A WELL-KNOWN company engaged on gas turbine development in London and north-west England has vacancies for technicians of all grades. Designers, aerodynamicists, performance engineers and mathematicians wishing to be considered for these interesting positions on work of national importance should write with all particulars, quoting Ref. HIC, to Box 5504. [7326

FLIGHT test observers and aerodynamicists, capable of performance reduction and analysis and preparation of reports, required for programme of civil and Service aircraft development. Good prospects for keen workers.—Apply, giving full particulars of training, experience, age and salary required, to Personnel Manager, Percival Aircraft, Ltd., The Airport, Luton, Beds. [0592

HANDLEY PAGE, Ltd., have vacancies for: (a) junior assistants, male or female, for work in their test house at Cricklewood, on material and process control; (b) junior and senior assistants of H.N.C. or degree standard for work in their mechanical and structural test depts. at Radlett.—Write, stating age and full particulars of qualifications and experience to, Staff Officer, Handley Page, Ltd., Claremont Road, London, N.W.2. [7336

HANDLEY PAGE, Ltd., have a vacancy for a technical assistant with a good mechanical engineering background, who will be required to carry out in connection with thermo-dynamic problems for aircraft air conditioning and thermal de-icing systems.—Write, stating age and giving particulars of qualifications and experience to, Staff Officer, Handley Page, Ltd., Claremont Road, London, N.W.2. [7335

DESIGN engineers wanted for experimental work on defence project. Previous experience required of any of the following: light engineering instruments, aircraft design, small electro-mechanical devices. Salary in accordance with experience and qualifications.—Please write, giving full details and salary required, quoting Ref. 2946C, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham Street, London, S.W.1. [7326

TECHNICAL assistants, both junior and senior, required in mechanical engineering department for work of national importance in connection with development of gas turbine engines. Excellent prospects exist in sections dealing with rig test of engine components, vibration, static structure test and research in gears and bearings. Qualifications: degree or H.N.C.—Apply: Reference No. VI, Armstrong Siddeley Motors, Ltd., Coventry. [0952

AIRCRAFT draughtsmen are required by the English Electric Co., Ltd., for employment at Warton and Acton, London. Men with good aircraft structure or jet engine installation and hot system experience would write, giving full details of their qualifications and experience, quoting Ref. 210G, Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham Street, London, S.W.1. [7275

BRITISH EUROPEAN AIRWAYS have vacancies at Northolt (to transfer later to London Airport) for planner ratefixers and planning engineers. Applicants should have served five years' engineering apprenticeship and have had at least five years' planning or ratefixing experience in aircraft construction or maintenance or in manufacture of aircraft engines, components or accessories. Salaries depending on qualifications, will be:
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ARMSTRONG SIDDELEY MOTORS have a few vacancies for senior and junior stressmen to do work on strength investigations and calculations on gas turbine aero engines. Degree, Higher National Certificate or equivalent essential. This is work of prime national importance. There are also a few vacancies for senior and junior stressmen for work on the installation of gas turbines in aircraft.—Apply in some detail to Reference SJS.1. [0960

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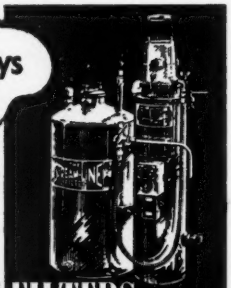

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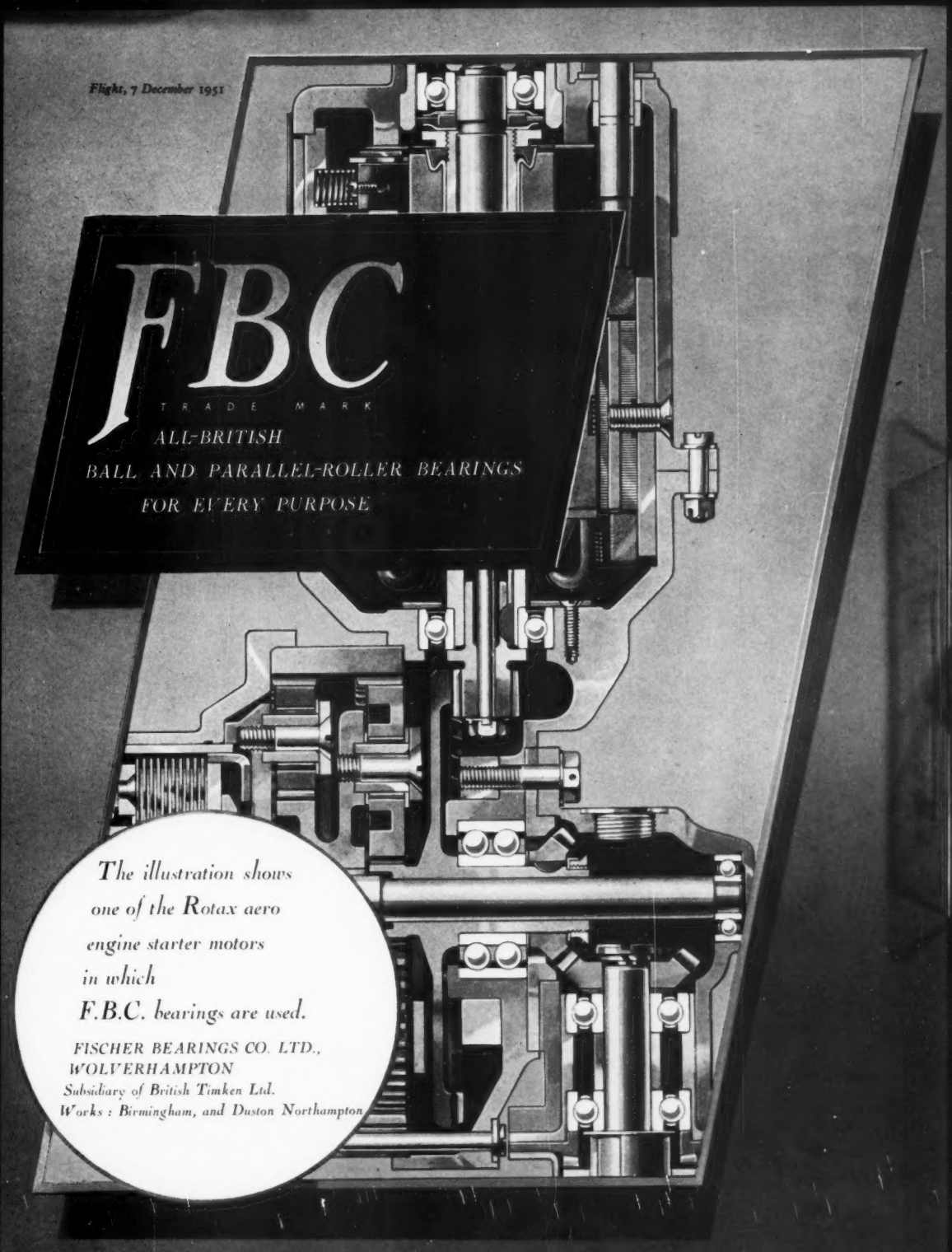

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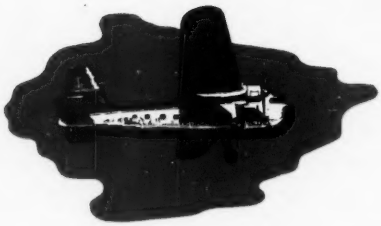

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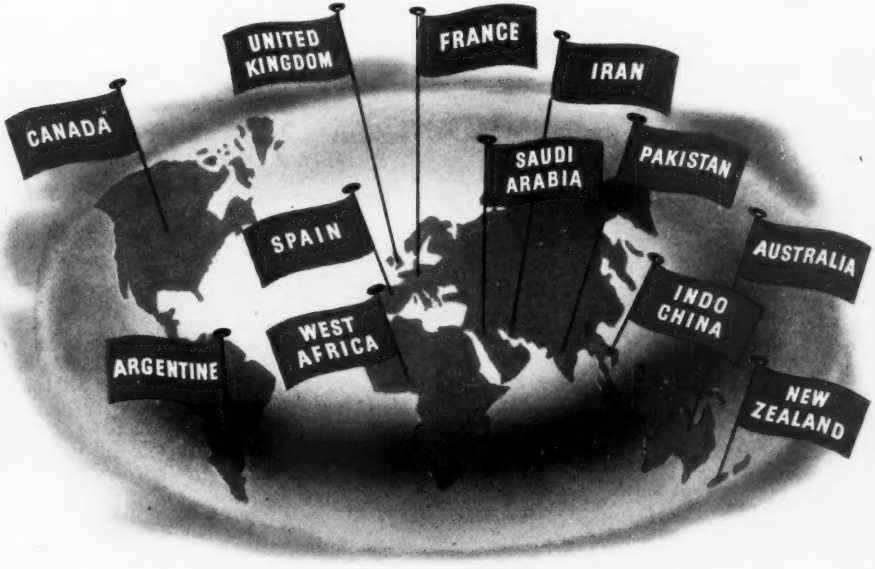

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